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THE NEW-BRUNSWICK TORNADO.

Remarks relating to the Tornado which visited New-Brunswick, in the State of New-Jersey, June 19, 1835, with a Plan and Schedule of the Prostrations observed on a section of its track. By W. C. Redfield, *Esq.**

[From the Lond. Phil. Mag. and Jour. of Science. Revised by the Author.]

In a paper printed in the American Journal of Science, in which I referred to the support given by Prof. Bache to Mr. Espy's theory of storms, at the meeting of the British Association in 1838, founded upon observations made on the New Brunswick tornado, I have stated, that in my own examinations I had observed numerous facts which appear to demonstrate the *whirling* character of this tornado, as well as the *inward* tendency of the whirling vortex at the surface of the ground; and further, that the direction of rotation was *towards the left*, as in the North Atlantic hurricanes.† It was due to Professor Bache that my observations should be brought forward; a task which has been too long delayed, partly from a desire that he would revise his former conclusions. The facts now presented form part of the evidence to which I then alluded.

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* [Communicated by Sir John F. W. Herschel, Bart.] This paper was intended by its author to have been read at the late meeting of the British Association in Glasgow, but was unfortunately detained.—J. F. W. H.

† Amer. Journ. of Science, Oct. 1838, vol. xxxv, pp. 206, 207.

If the effects which I present for consideration be due to "a moving column of rarefied air without any whirling motion at or near the surface of the ground," as maintained by Professor Bache,* we might expect to find a relative uniformity in these effects on the two opposite sides or margins of the track. How far this is the case may be seen by inspecting the observations which are found upon the annexed plan of prostrations.

The occurrence of these tornadoes appears to have been noticed from the earliest antiquity; and their violence has been considered as the effect of an active whirling motion in the body of the tornado; this peculiarity of action having often been supported by the testimony of eye-witnesses.

The whirling motion, however, has not been recognized by Prof. Bache, Mr. Espy,† or Prof. Walter R. Johnson,‡ in their several accounts of the New-Brunswick tornado; these writers having been led to adopt or favor a theory of ascending columns in the atmosphere, founded on the supposed influence of calorific expansion accompanying the condensation of vapor.

It is remarkable that previous to this period the evidences of the rotation or other characteristic action of tornadoes appear not to have been duly examined and recorded, nor even to have received the distinct consideration of scientific observers. We are therefore left to seek out the peculiarities of their action, by examining the direction of the prostrations and other effects of the wind; and from a careful induction from the effects which are thus registered as by the finger of the tornado, we may hope to arrive at satisfactory conclusions.

If the numerous prostrations of trees and other objects, which may be observed in the path of a tornado, be the effects of a violent whirlwind, it appears most reasonable to infer that this whirl had the common properties which may be observed in all narrow and violent vortices, viz. *a spirally descending and involuted motion* of the exterior and lower portions of the vortex, rapidly quickened in its gyrations as it approaches toward the centre or axis of the whirl, and thence continued (in the case

* Transactions of Amer. Phil. Society, vol. v, p. 417, New Series.

† Trans. Amer. Phil. Society, vol. v, New Series.

‡ Journ. Academy Nat. Sciences of Philadelphia, vol vii, part ii.

of the whirlwind) spirally upward, but gradually expanding in its spiral course by an evolute motion in ascending towards the extreme height of the revolving mass.

If we now contemplate the action of this whirling body, while in a state of rapid progression, on the several objects found in distinct portions of its path, we may expect to witness effects of much complexity, particularly as regards direction; and, also, that amid this apparent complexity, some clue may be obtained that will serve to indicate or establish the true character of its action. Some of the effects which may be expected, or observed, will be here considered.

1. We may expect to find, in the path of the whirlwind, strong evidence of the inward or vorticular course of the wind at the earth's surface; the violence of which inward motion is clearly indicated by the force with which various objects, often of much weight, are carried spirally upward about the axis of the revolving body.

Now the effects of this inward vorticular motion at the surface of the ground, are clearly manifested in the cases before us; and are also well illustrated by Prof. Bache, in his paper on this tornado, although referred by him to a different action.*

2. As the effects which may be observed at various points in the track were produced at different moments of time, and by forces acting in different directions, as well as of various intensities, we may expect to find great diversities in the several directions of the fallen trees and other prostrated bodies; and further, as all the forces, in addition to their inward tendency, have likewise a common tendency in the direction pursued by the tornado, we may expect to find, also, full evidence of this progressive force in the direction of the fallen bodies.

These effects, I need hardly state, are distinctly observed in the case before us; and appear likewise from the observations of Professor Bache. The results already noticed have been observed also in the tracks of other tornadoes: so that a general inclination, both inward and onward, amid the various and confused directions of the fallen bodies, is distinctly recognized by all parties to this inquiry.

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* Transactions of American Philosophical Society, vol. v.

3. It has been often noticed, that where two fallen trees are found lying across each other, the uppermost or last fallen points most nearly to the course pursued by the tornado.

In view of the facts above stated, much pains have been taken to establish, by induction, a central and non-whirling course in the wind of the tornado; first inward and then upward, like that resulting from a common fire in the open air. I do not propose to notice the insuperable difficulties which appear to attend this hypothesis. It is important to state, however, that all the above mentioned effects, when theoretically considered, are, at least, equally consistent with the involute whirling action of an advancing vortex. This important consideration I have not seen recognized by the advocates of the non-whirling theory; and it seems proper, therefore, to point out, as we proceed, other and more distinguishing effects of the whirling action.

4. It has been noticed, also, that the directions given to broken limbs and other bodies, by the successive changes in the direction of the wind as the tornado passed over, have been found in opposite courses of change, on the two opposite sides of the track.

This fact, too, has been strongly urged as disproving a rotary motion. But, unfortunately for the objection, this effect accords fully with the rotary action of a progressive mass of atmosphere; as is well known to all who clearly understand the *theory* of rotary storms.

In all such whirling masses the successive changes in the direction of the wind *result solely from their progressive motion*, and necessarily take place in opposite directions or courses of change on the two opposite sides of the advancing axis. This indication fails, therefore, as a theoretic test; and I now proceed to notice others, which are peculiar to a progressive whirling action.

5. In considering further the effects of such action, we may expect to find that the greatly increased activity of gyration which is always observed near the centre of a vortex, will be indicated by a more violent and irregular action in and near the path pursued by the axis of the whirlwind, than is found under its more outward portions.

This effect is often strikingly exhibited in the path of tornadoes; while, in the supposed ascent of a non-whirling column, it would seem that no part of the surface would be so much exempted from its action, and particularly from its power of prostration, as that lying near its centre.

6. As the effect of rotation must be to produce, on one side of the advancing axis, a reverse motion which is contrary to the course of the tornado, it is evident that on this side the prostrating power will be much lessened; that the cases of prostration, therefore, will be here less numerous; and that some of these, at least, will be produced in a backward direction, more or less opposite to the course of the tornado. By this criterion, not only the whirling movement, but the direction of the rotation also, may be clearly ascertained.

This effect is best observed by comparing the two opposite margins of the track, and is strongly exemplified in the case before us. Here we find, that most of the trees prostrated within five chains (110 yards) from the northern or left-hand margin of the track, lie in directions which are more or less backward from the course of the tornado. The prostrations in this part of the track are also for the most part less general than on the opposite side of the axis,* a greater portion of the trees being left standing.

It sometimes happens, owing perhaps to the inward or involute motion having exceeded the progressive motion at a particular point, that some inclination backward will be found in the prostrations on the progressive side of the whirl, as seen on the sketch, Nos. 77 to 80. But these unfrequent cases by no means compare with the numerous backward and sometimes *outward* prostrations, found on the reverse side of the whirl, as illustrated by Nos. 1, 3, 4, 7, 9, 10, 12, 13, &c. on the left side of the track. Thus we find here a satisfactory indication that this tornado was a whirlwind; and that the course of its rotation was to the *left* in front.

7. It is also apparent, that the prostrating power of a whirl-

* There was a vacant space in the belt of wood, immediately to the right of the line *c c* or axis of the tornado, owing to which the effect mentioned does not appear so obvious in the figure.

wind on the side of its reversed motion as just considered, will be limited to a shorter distance than on the opposite or progressive side of its axis.

This is seen in the more limited *extent* of the prostrations on the north or left margin of the track, as compared with the extent of those which incline inward on the right side of the apparent axis. There were many trees standing beyond the northern border of the track, but none had fallen.

8. It follows, in like manner, that on that side of a whirlwind in which the rotary motion coincides with the progressive movement, the prostrating power will not only be increased in its intensity, but will also be effective over a wider space; and that few, if any, of the prostrated bodies will be found to have been thrown backward.

In the case before us, as may be seen in the sketch, the prostrations are found to extend on the southern or right side of the apparent axis to a distance nearly twice as great as on the left side. The same general result has also been noticed in the tracks of other tornadoes which I have examined.

The facts here considered are too important to be overlooked, and seem fully to establish both the whirling action and the course of rotation.

9. If a rotative action be exhibited, the mean directions of all the prostrations, on each of the two opposite sides, will differ greatly in their respective inclinations to the line of progress, and the mean direction of those on the reverse side will be found more backward than on the opposite side, where the rotative course coincides with the progressive action.

In the case before us, the mean direction of all the prostrations on the right side of the track is found to incline 52 degrees inward from the line of progress. The course of the tornado is here taken to be east; although for the last half mile its course had been a little north of east. On the left side, the mean direction is found to be S. 3° W., or 93 degrees inward and backward; a difference in the mean inclination from the course on the two sides of 41 degrees.*

* The inclinations of the fallen trees from the course, on both sides the axis, are reckoned inward and backward.

If we now take the indications afforded by the two exterior portions of the track, to the width of five chains on each side, where the effects are more distinctive in their character, we find on the right side a mean inward inclination of 46 degrees, the mean direction being N. 44° E.; while on the left side of the track the mean inclination is not only inward but 48 degrees backward, the mean direction on this side being S. 48° W. We have thus a mean difference in the inclination of the fallen trees, on the two exterior portions of the track, of no less than 92 degrees.

These indications seem conclusive, also, in favor of the whirling action in the direction from right to left.

10. Although of less importance, it should be mentioned that the diminished action of the tornado which is commonly observed on the hillsides and summits over which it passes, and the greatly increased action in the bottoms of the valleys, and even in deep ravines, afford a strong argument against ascribing the effects to the ascent of a non-whirling rarefied column; as the latter, it would seem, must act with greater force on the hillsides and summits than in the bottoms of valleys. The general correctness of the observation above stated cannot justly be questioned.

11. The sudden and extraordinary diminution of the atmospheric pressure which is said to take place at the points successively passed over by a tornado, causing the doors and windows of buildings to burst outwards, seems to afford strong confirmation of a violent whirling motion; for an effect of this kind is necessarily due to the centrifugal and upward force of the vorticular action in the interior portion of the whirlwind. There are no other means known by which such an abstraction of pressure can be effected in the open air. An increase of calorific elasticity, if such were produced, either generally or locally, would not greatly disturb the equilibrium of pressure, being resisted by the surrounding and incumbent weight of the entire atmosphere. Besides, the immediate effect of such increased elasticity might rather be to burst *inward* the windows and doors of buildings exposed to its action.

Some of the more important indications mentioned above

appear also from an examination of Prof. Bache's observations; although the latter are not definitely located by him, as regards the extreme borders of the track. Thus, in Fig. 7 of Professor Bache's paper, assuming the course of the tornado to be east, and rejecting a few observations near the centre, to avoid error, we find in twenty observations on the right side of the track, a mean inward inclination of 64 degrees, and for nine observations on the left side, a mean inclination, reckoned inward and backward from the course, of 104 degrees, being 14 degrees backward.

It is stated by Prof. Bache, "that the trees lying perpendicular to the track of the storm, are not those furthest from the centre of that track." This generalization accords with my own observations; but can hardly be reconciled with an inward non-whirling motion in the tornado.

It may appear to some, that in the case of a whirlwind the greater portion of the prostrations on the reverse side of the axis should be found in a backward direction; and so they would undoubtedly be found, were it not for the inward and the progressive action. But the force is here so far lessened by the reverse action above noticed, that in most cases only a small portion of the trees exposed will be thus prostrated; while the greatest force of the whirlwind, on this side, is felt near its last or closing portion and towards the apparent axis, where the inward, together with the rotative and progressive forces, seem to combine their influence in the closing rush towards the heart of the receding vortex. This appears to account for the nearly opposite directions of prostration found on this side, and it is apparently by this more violent closing action, that many trees which were first overthrown in a direction nearly across the centre of the path, were again moved from their position, or swept onward nearly in the course of the tornado. It is proper to remark here, that an attentive examination of these effects has served to convince me that on the right and more central portions of the track the prostrations for the most part take place either at the outset or under the middle portions of the whirlwind; while on the left or reverse side, up to the line of the apparent axis, and even across the latter, they occur

chiefly under the closing action of the whirl, as above described. The violent effects of this central and closing action are more clearly seen as we advance from the left-hand margin towards the centre or apparent axis of the path.

From the causes to which I have just alluded, the effects are usually more violent on and near the line passed over by the axis, than in other portions of the track. This line of greatest violence is found to coincide nearly with the line which separates the inwardly inclined prostrations of the two opposite sides of the track.* The latter line or apparent axis of the track is sometimes called the line of convergence, and is indicated on the figure by the line and arrow *c c*. Along this line, from the causes just mentioned, aided also by the elevating forces about the axis, many of the trees are swept onward, and left with their tops in a direction nearly parallel to the course of the tornado; forming an apparent, but not a just exception, to the more lateral direction which pertains to most of the trees prostrated by the onset of the whirlwind, near the central portions of the track. Indeed, the central or closing violence of the advancing whirl is here so great, that the trees are not unfrequently torn out of the ground and carried onward to considerable distances.

It is proper to state here, that in the tracks of all the tornadoes which I have had opportunity to examine, and in some, at least, of those examined by others, the course of rotation has been found the same as in the case before us.†

In order to make a just and satisfactory examination of the effects of a tornado, it appears necessary to select portions of the track where the extension of wood or single trees, on each side, is found sufficient to mark clearly the exterior limits of the prostrating power, and where the effects on both sides of the axis are also clearly developed. Our next care should be to ascertain, as near as may be practicable, the line which sepa-

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* The line of greatest violence, for the most part, is found somewhat to the right of the line of convergence.

† As in the tornado which passed through Allegany county, New-York, July 25th, 1838; described by Mr. Gaylord in the American Journal of Science, vol. xxxvii, p. 92.

rates the opposite convergence of the two sides, noticed above as the axis or line of convergence. We should then determine the general direction of this line and of the track at the place examined; which being done, we may proceed to measure the distance to which the prostrations are extended on each side, and then carefully to take the position and direction of prostration of each and of all of the fallen bodies, noting with care, also, any other phenomena which may serve to aid our inquiries. We may thus obtain valuable materials for future analysis; and this course of investigation, if faithfully pursued, will, it is believed, remove all reasonable doubt of the rotative action of these tornadoes. An examination of their probable origin, and the causes of their enduring activity and violence, belongs not to the present occasion.

New-York, 5th February, 1841.

For the American Repertory.

LONG AND SHORT CONNECTING RODS.

In looking over the last number of the Repertory, (February) I perceived an article by an engineer of no less note than Mr. John Seaward, advancing a very strange theory respecting the relative effect produced by the use of long and short connecting rods in steam-engines.

If the opinion advanced by him be correct, and based upon correct premises, engineers should one and all immediately reduce the length of these rods, in all their future operations, to the length of the crank, or even shorter. For it is evident, that if his *geometrical investigation* holds good in comparing a rod of three times the length of the crank, with one of six times that length, it will hold equally good in comparing one of *once* the length of the crank with one of six times that length; and if he had placed in his table there presented another column, calculated by the same formula, showing the effect of a rod once the length of the crank, he would have produced, upon adding it up, the same gross result as with the other two rods.

I would here mention some facts connected with this subject, that are probably unknown to most of the readers of the Reper-

tory. Mr. Seaward has recently built the engines for two steam vessels for the British Government, upon a plan invented (and patented, I believe) by himself: their names are the "Gorgon" and "Cyclops." In these engines the cylinders were set directly under the water-wheel shaft, and the connecting rod was attached directly to the crosshead of the piston-rod and to the pin of the crank; but in order to do this in steam vessels of the ordinary depth, and at the same time have the stroke of the piston at all approaching that of the ordinary engines for vessels of the same depth, it was necessary to make the connecting rod much shorter than usual, viz. about three times the length of the crank.

We will now show the effective power of the Gorgon engines by facts, stated to us by a gentleman well acquainted with steam vessels, who traveled a number of miles in this steamer, and who obtained the dimensions of the vessel and engines, and the greatest number of revolutions ever produced by the latter, from the officers on board at the time: the dimensions of the water-wheels were taken by himself.

The engines had cylinders of 64 inches diameter and $5\frac{1}{2}$ feet stroke, and the ordinary pressure of steam 40 lbs.; the water wheels were $26\frac{1}{3}$ feet diameter, 7 feet wide, with two buckets or floats of 7 inches in width only. The vessel is 183 feet in length, $37\frac{1}{2}$ feet beam, and 23 feet hold, and her medium draught of water is 14 feet. The greatest number of revolutions per minute that these engines were capable of driving the wheels, which have a resistance very small in proportion to the size of the engines, was 19, and the utmost speed of the vessel through the water was 9 statute miles per hour.

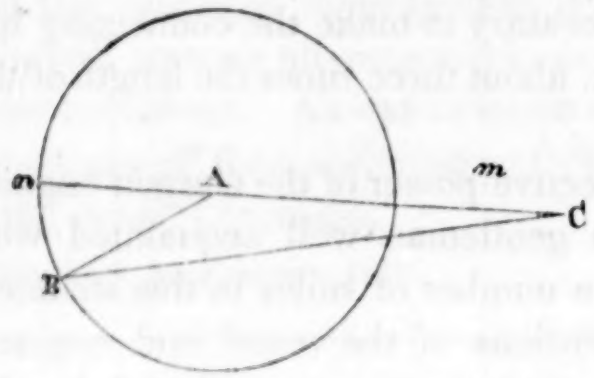
Any engineer acquainted with the subject well knows that this effect falls far short of that which should have been produced by engines of these dimensions. We are not surprised that after thus failing to prove practically the efficiency of his engines, that he should endeavor to do it by a *geometrical investigation.*

But, as we have before intimated, Mr. Seaward was unable, even by making the connecting rod only three times the length of the crank, to get the usual length of stroke for the same

depth of hold, although it was desirable. Now, if he had implicit faith in the *geometrical* investigation put forth in his article, why did he not reduce the connecting rod to twice or once the length of the crank, in order to get this desirable length of stroke?

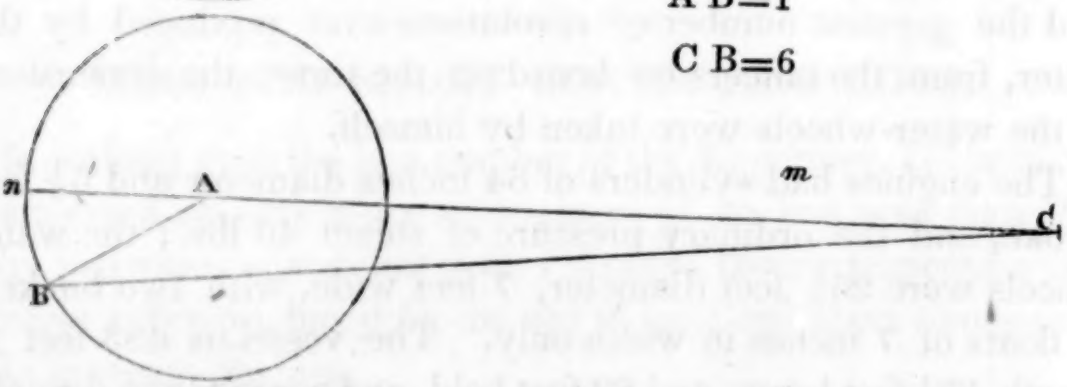
Having thus by these preliminary remarks introduced the subject, we will now endeavor to show that Mr. Seaward's investigation is based upon false premises, and consequently his results incorrect.

MR. SEAWARD'S DIAGRAMS.



A B=1

C B=3



A B=1

C B=6

The formula by which his table is calculated is this:—

The effective force varies as sin. $\angle$B $\times$ sec. $\angle$C.

The error in this formula, which will be sufficiently evident upon examination, arises from assuming the effective force to turn the crank to be *directly* as the sine of the angle B, and the secant of the angle C; whereas it is *directly* as the former, but *inversely* as the latter; and the correct formula would be thus expressed:—

$$\text{The effective force varies as } \frac{\text{sin. } \angle \text{B}}{\text{sec. } \angle \text{C}}.$$

We here present a table, similar to Mr. Seaward's, of the effective force, with the crank in different positions, but calculated by what we conceive to be the correct formula, given above.

It will be seen by examining this table, that we arrive at very different results from those presented in Mr. Seaward's table; and instead of the power exerted to turn the crank being the same in both cases, it is as 106 is to 112; or the difference somewhat exceeds 5 per cent of the whole power exerted upon the piston.

Angle of Crank.	Effective force of turning round the crank with a connecting rod 3 times its length.	Effective force of turning round the crank with a connecting rod 6 times its length.	Relative friction upon journals B and C, with a connecting rod 3 times the length of crank	Relative friction upon journals B and C, with a connecting rod 6 times the length of crank
00°	000	000	0.000	0.000
10	116	145	8.762	8.461
20	234	287	9.057	8.756
30	344	425	9.222	8.921
40	453	554	9.331	9.030
50	557	670	9.407	9.106
60	656	784	9.460	9.159
70	746	864	9.496	9.195
80	825	930	9.516	9.215
90	892	972	9.523	9.222
100	962	986	9.546	9.215
110	950	970	9.496	9.195
120	932	919	9.460	9.159
130	875	844	9.884	9.106
140	840	717	9.331	9.030
150	628	568	9.222	8.921
160	444	394	9.057	8.756
170	228	242	8.762	8.461
180	000	000	0.000	0.000
	10,682	11,271	158,532	152,908

In the foregoing table we have added two columns not given in Mr. Seaward's, showing the relative friction in the two cases.

It will be quite plain, upon examining the diagrams, that the angular thrust or action at the point C will vary with the crank in its different positions, as the sines of the angle A C B, and not as the secants, as stated by Mr. S.; and it is also evident, that the pressure upon the points B and C, in the direction of the line B C, and consequently the friction at these points, will vary in the same manner. The numbers given in the 4th and 5th columns of the table are therefore the sines of the angle C, with the crank in its different positions.

By reference to the sum of these sines, we find that the friction in the two cases, supposing the angular motion the same in both of them, is as 158 : 153 nearly; but the angular motion in the case of the rod three times the length of the crank is double that of one six times that length; therefore, the true relative friction will be as $158 \times 2 = 316 : 153$, or the friction with the short rod is more than double that with the long one.

Mr. S. in his remarks upon this subject, says :—"There was a time when many persons deluded themselves with the idea, that by a certain arrangement of long or short rods, levers, cranks, &c. they could actually produce power or obtain an increase of power; but, though this folly is happily exploded, it seems only to have given place to another error equally irrational and absurd; for it is perfectly demonstrable, that while on the one hand, no arrangement of levers, rods or cranks will produce or give power, so on the other hand no mechanical arrangement whatever can be productive of a loss or diminution of power," &c. Now the reason, if we rightly understand it, why engineers prefer the long rod is not that in the use of the short rod any of the power applied is *actually lost*, but that it is lost so far as producing the desired *available effect* is concerned, viz. to turn the crank; and they have come to what we consider a very rational conclusion in supposing that the greater the angle through which the power is transmitted to the crank, the greater will be the loss of power *so far as turning the crank is concerned.* And here I would ask once more, if Mr. S. is satisfied that the theory advanced by him be the true one, why does he not make his connecting rods twice, or even once the length of the crank, instead of three times, and thereby save the extra weight, space, &c. consequent upon the use of the length he has adopted?

One thing we had almost forgotten to mention, that shows very conclusively the fallacy of both the theory and table given by Mr. Seaward: it is, that when the crank is at the angles 100, 110, and 120° with the short rods, and at 100° with the long rod, the power to turn the crank is represented as greater than that acting upon the piston. Now, we feel fully satisfied that no engineer of a sound mind and common understanding would pretend that by transmitting the power through the angle

at C, it was to be increased; besides, it is in direct contradiction to his own assertion, that "no arrangement of levers, rods or cranks will produce or give power." How this contradiction is to be reconciled, we cannot understand; we leave this to Mr. Seaward. C.

WOOD PAVEMENT.

(CONTINUED.)

Since the publication of the preceding part of this paper, a plan of shaping blocks of wood for paving, which differs from all we have heretofore described, has been exhibited at the rooms of the American Institute in this city, where, we believe, it yet remains for public inspection. The blocks are rectangular in their proportions, and vary but little from the cube: they are placed in rows, running crosswise of the street, and the peculiarity of the plan consists in cutting shoulders upon two of the lateral faces of each block, so that it may support, and be supported by, the two blocks that are contiguous to it in the same row. The accompanying cut represents one of the faces of a block thus prepared: the divisions *a* and *b* are the parts cut away to a sufficient depth to form shoulders, that by interlocking with the next block, the face of which is cut in a corresponding manner, produce mutual support, and counteract any accidental tendency in either to become displaced.—This plan possesses the disadvantage, if it may be so considered, of forming continuous straight lines running crosswise of the street; but a much more serious, if not indeed a fatal objection to it, will be the increased cost of cutting the blocks to the required form.

We have endeavored to give a brief but accurate description of all the plans that a diligent search has disclosed to us possessing any distinctive characteristics—we will not say merit, for the term would be misapplied to most of them; and it remains only for us to speak under this head of some general matters, upon which the durability and value of a wood pavement depend in no inconsiderable degree.

The first exercise of care is called for in getting out the

blocks. These should be taken only from the heart or more solid part of the tree, which is less destructible than the sap either by wear or decay, and should be cut of exactly equal lengths. A perfect uniformity in length, which may easily be obtained by cutting the blocks to a guage, is a very important property, as it permits the use of a foundation much more firm than could be employed, if the blocks from difference of length had, after they were laid, to be forcibly driven down to produce the required evenness of surface; and in a well constructed road, the slightest inequality that can be remedied is inadmissible; for it is evident that whatever difference of height may at any time exist between the upper faces of two adjoining blocks, will be constantly increased by the travel over them, as the wheels of a vehicle in passing from the higher block to the lower, will fall with the force of a blow, while in passing from the lower to the higher it will only act as so much dead weight. It is desirable also that the blocks should be cut as truly to the figure adopted as manual skill or machinery can cut them. A very little inattention to this part of the process will produce so much irregularity of shape, particularly with the hexagonal prism, as to cause large fissures in the pavement, and very much impair its stability. The foundation should be very firm and smooth; and if it is contemplated to lay the blocks immediately upon the subsoil, it should be prepared by having the surface well and evenly rammed. A thin layer of sand—say half an inch in thickness—should be strewed upon the foundation before the blocks are placed upon it. A wood pavement, when wet, possesses a considerable degree of slipperyness, which becomes more dangerous to horses not rough shod, if the street has much inclination: it should therefore have no more slope given to it than is necessary to prevent an accumulation of water upon it during a rain. Hitherto the woods most commonly used for paving have been hemlock, fir, white pine, and some others of inferior density: in some few instances woods of greater hardness have been used, but with no extraordinary results.

Experiments and Results.—The piece of wood pavement in Broadway, to which we referred under the head of modes of

construction, is the first that claims a notice for its results. We shall briefly recapitulate such portions of the description as were before given, and add whatever other particulars that may be necessary to give such a notice its fullest value. This piece of road, 125 feet in length, was put down in the summer of 1835, upon a paved foundation, one-third of which was formed of the round beach stones, such as are generally used here and in other cities for paving; one-third of flagging stones 4 inches thick, and the remainder of a bed, one foot deep, of fragments of stones broken as if for macadamizing. The blocks were hexagonal prisms of seasoned hemlock, 12 inches in length, and cut from a circle of 9 inches the diameter: after they were settled firmly upon the foundation, the surface was coated plentifully with melted pitch, and upon this again was strewed a layer of gravel. This pavement has needed but few repairs. Very soon after it was laid, two or three blocks gave way: an examination of them, upon their being taken up, led to the conclusion that they had been affected by dry rot prior to the time they were laid down. With this exception, nothing has been done to it until the latter part of last summer, when it underwent a partial renovation. It is worthy of remark that in this latter instance, also, the defects were attributable to a decay of the blocks, which had become so rotten at the base and for several inches upward that they were unable to sustain the weights to which they had been exposed. It has, however, suffered very considerably from the traveling over it during the past winter; many of the blocks have sunk to the depth of from four to six inches, and it will need early in the coming season very thorough repairs, if not entire new relaying. The duration of such a piece of pavement under similar circumstances may, therefore, be fairly set down at six years, or three times that of the pavement of beach stones in Broadway, which has to be renewed, or repaired equivalent to a renewal, every two years. This relative durability of the two kinds of paving will of course only hold good with reference to a busy thoroughfare. Some estimate of the actual stability of the wood pavement may be formed from the following data:—A mass of marble weighing 12 tons, suspended from a truck weighing probably 3 tons, was

transported across it without producing any visible derangement or depression of the blocks: there are daily about 1500 passages made across it by the stages that ply between the lower and upper parts of the city, beside the countless number by hacks, cabs, carts, wagons, and private vehicles of every description. The pavement, though much broken, presents an appearance so uniform throughout its whole length, that it would be impossible, from a superficial examination, to mark either of the dividing lines between the foundations.

Another experiment upon paving, scarcely inferior in important results to the preceding, was made in Mill street, of this city. This specimen, which is several hundred feet in extent, was laid in 1837. The Street Commissioner, after two years examination of the paving in Broadway, came to the conclusion that blocks of less depth than were there used would answer equally well, and that expensive foundations and the coating of pitch were both unnecessary. He therefore used, for the Mill street paving, hexagonal prisms, having a diameter about the same as in the former case, but a depth of only 8 inches. They were placed merely upon a bed of gravel, firmly packed, and extended from curb to curb, forming the gutters also of the street: the interstices between the blocks were filled with sand. The principal wear to which this pavement is exposed is from carts laden with merchandise: these are comparatively few in number, and the case therefore offers an extreme opposed to that in Broadway. The street has not as yet needed any repairs, and so far as we can judge of its condition for the snow and ice upon it, the surface is perfectly unbroken.

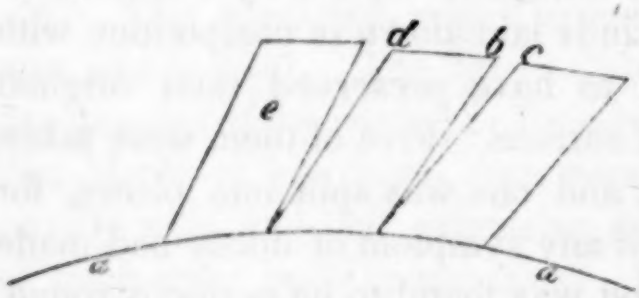
Several pieces of pavement upon Mr. Stead's plan, the next named under the head of modes of construction, have been put down in the city of London. The history of one of these is of surpassing importance, and we select it therefore, as the representative of the whole. This experiment was made in Oxford street. In November, 1838, Mr. Stead was invited to lay down a piece of wood paving in this busy avenue of the metropolis, for comparison with several specimens of pavements composed of other materials, as granite, asphaltum, and some artificial bituminous compositions. In this instance the blocks were

hexagonal prisms of kyanized fir, 7 inches diameter and 15 inches deep. Part of them were placed upon a foundation of planks $1\frac{1}{2}$ inch thick, and part upon a well prepared macadamized surface. To complete the whole, a mixture of melted pitch and sand was poured upon and between the blocks. At the expiration of the time, about one year, allowed for testing the durability of the several kinds of paving experimented upon, a committee from the parish vestry was directed to examine the specimens, and report as to which plan it was most advisable to adopt for paving the whole of Oxford street. This investigation resulted in establishing the superiority of the wood paving over all the other kinds laid down in competition with it; the blocks were found to have preserved their original smoothness and evenness of surface. Five of them were taken up and minutely examined, and one was split into pieces, for the purpose of discovering if any symptom of decay had made its appearance: but the wood was found to be perfectly sound, and the diminution of the blocks was scarcely perceptible. The committee reported that the wood pavement had proved itself fully equal to the travel of the thoroughfare in which it had been placed, and recommended that the entire street be paved in that manner.—Notwithstanding this high encomium, as a faithful chronicler we are bound to state some comparative disadvantages that the plan of Mr. Stead possesses: these are but few, however, and depend wholly upon the diminishing shape he gives to the blocks. (See Figs. 4, 5 and 6 of the illustrations of wood pavements in the preceding number of the Repertory.) This departure from the primitive forms of the cube, hexagonal prism, &c. though slight, would very much increase the cost of cutting the blocks; while a pavement constructed with them, if formed with the accuracy the plan contemplates would be *too compact*, and from that circumstance more likely to become disarranged by the tendency the blocks have to displace each other when swelled by moisture. True, this tendency is counteracted by the use of dowels, though it exists in none the less force.

The plans of Messrs. Brown and Carey, which follow next in order, do not merit any further notice than we have already

given them. They have never been tried, so far as we can learn, and we have elsewhere stated the objections against them, which are in effect insuperable.

The plans of Mr. Parkin, the Count de Lisle, and Mr. Grimman, possess, in common, a peculiarity so decidedly fatal to them, that it will be necessary to include them in one notice. This feature is the inclined block, which we shall demonstrably show cannot be used as these patentees contemplate, nor at any other variation from a perpendicular to the surface upon which they are laid, if the sides of the block be parallel, without injury to the firmness of the pavement.—Let *a a* represent the grading upon which blocks are placed, whose sides are inclined to the horizon. The curve necessary to be given to the grading, that the surface of the road may have the proper slope for carrying off the rain, is heightened a little, to show the effect of placing inclined blocks upon it; but it is apparent that whatever that curve may be, the blocks will be in perfect contact only at the base, and the distance between them will gradually increase to the surface; and it will further be seen that every block becomes a lever, whenever a weight is placed upon it, at any point between the angles *b* and *c*; and that the effect of moving this lever through the space *b d*, as a weight so placed will move it, is the forcing up of the adjoining block *e* out of its bed. Pinning the blocks together is but another attempt to *cure* an evil that might better have been *prevented*.—It would seem hardly possible that this defect should not have been observed even upon the most cursory glance at either of the plans; but as if to show how little attention is sometimes given to subjects coming under editorial notice, some of the English journals have actually indorsed the utility of two of these modes. With the projectors themselves the delusion appears in the most marked manner. It has, as we have already stated, led in one instance to a resort to litigation upon the subject of their conflicting claims; in others it has been productive of much specious reasoning upon the imagined advantages of inclined



blocks, and one patentee has even gravely asserted that the particular angle he adopts renders the upper surface less slippery to the horses' feet than if the fibres were perpendicular. There is no invention so worthless but it will find advocates: it should not excite surprise, therefore, that these plans have their friends. One of them, Count de Lisle's plan, has even been adopted by a paving company, and several pieces of pavement, constructed according to it, have been put down in London. In one specimen, laid in Parliament street, the natural defects of the plan were so little guarded against, that the pavement, by only two days travel over it, became impassable, and had to be fenced in to prevent accidents: in most of the other cases, superior workmanship and care rendered the specimens more durable. That no degree of skill or care, however, can make a pavement of this kind equal to one of perpendicular blocks laid properly and pinned together, though in a less expensive manner, will be apparent upon the slightest reflection. The plan—and what we say of this will apply to all others where inclined blocks are used—is virtually defective; and though a pavement constructed upon it were to possess firm abutments and a perfectly level foundation, which latter in street paving is impracticable, still it would be more liable to become unstable than a pavement of upright blocks.

The very vague description of the plan of Mr. Geary to which we were confined, must render valueless, except for its general bearing upon wood pavements, whatever information we might otherwise desire to give respecting some experimental applications of it. We shall merely state, therefore, that the specimen of paving spoken of in the former part of this paper, was laid down for competition with a piece upon Stead's plan. There seems not to have been the requisite degree of care exercised in their construction, as we gather from some strictures upon them that appeared at the time: the blocks for Stead's specimen, in particular, greatly lacked uniformity of length and shape; notwithstanding this, the pavements have suffered very little from use; and with no perceptible difference that would lead to a choice between them. They have been less affected by frost, it is said, than some other wood paving in London.

It would be vain to offer any remarks predicated upon the foregoing experiments as to the general durability and economy of a wood pavement, since these are liable to change with every variation of place and circumstance; but it possesses some advantages comparatively with pavements of stone or other materials that may be termed unalterable; as, less rapid accumulations of dirt in dry weather, and mud in wet, a property that necessarily involves a saving in the cost of keeping it clean; an even surface, far more comfortable to ride over, and less injurious to horse as well as vehicle, which derives its value in no small degree from the inelastic property possessed by wood, that produces less tremor in a body rolling over it than an equally smooth surface of any other material suitable for paving; a comparative cessation of the noise, that renders conversation between pedestrians in a busy thoroughfare so painful, and heightens the anguish of the invalid who lies within its influence; and finally, if we may believe the declaration of many observers, it is less affected by frosts or changes of temperature than all other kinds of paving. To offset this array, it has but a single disadvantage peculiar to itself, that of being slippery in wet weather; and this may be effectually obviated by having all horses rough-shod that travel over it.

We know not what the convictions of the reader may be: for ourselves, we have arrived at the conclusion that all attempts to improve upon the forms of the blocks first used for paving have been but a waste of human ingenuity, and that the various modifications we have named possess a value *inversely* to their departure from the simple cube or prism. Until some cheap and efficient means of preventing rot shall be adopted, it is very questionable whether even the trifling additional cost of doweling the blocks together will be compensated for by greater durability in the pavement.

Some suggestions for furthering a more extended introduction of wood pavements into this city, that we partly proposed to give under a supplementary head in this paper, will, together with a notice of several recent inventions for preserving wood, be made the subject of a future article.

For the American Repertory.

ON THE EFFECTS OF ARTS, TRADES, AND PROFESSIONS, AS WELL AS HABITS OF LIVING, ON HEALTH AND LONGEVITY.

No. VIII.

According to the arrangement proposed in the commencement of our series, we have now arrived at the *second class* of causes affecting health and longevity, embracing three divisions, viz: 1. *The undue exertion of particular organs, with or without insufficient exercise of other parts.*—2. *Unnatural or constrained positions in different employments.*—3. *Temperature and moisture.*

We have already alluded to the evils consequent on undue exercise of the muscular system in general, such as hernia, aneurism of the large vessels, hemorrhages from the lungs and nose, and dilatation of the cavities of the heart: to these may be added, sprains and lacerations of the muscles, injuries of the ligaments and invertebral spaces, &c. Thus, we sometimes see the *patella* or knee-pan fractured by a violent effort at leaping, and the *tendo-achilles* ruptured by the same cause; and we have lately known the walls of the heart give way by a sudden exertion of lifting a heavy weight. We, however, witness the evil effects of over exertion of particular organs most strikingly manifested where the other parts of the muscular system suffer from inaction. This may be illustrated by reference to an affection of the *vocal organs*, so prevalent of late among clergymen. Various causes have been assigned for this disease, *(bronchitis)* such as the use of anthracite coal, wearing cravats, constrained posture in public prayer, speaking in basements or other damp or ill-ventilated places, reading the funeral service with the head uncovered, &c. &c.; but the chief cause, in our opinion, is *exercising the vocal organs disproportionately to the rest of the body.* Were the whole system hardened by systematic exercise, we should rarely meet with bronchitis, caused by the ordinary efforts of public speaking. We seldom observe this affection among the itinerant Methodist clergy, whose active habits of life tend to invigorate the corporeal powers; nor was

it known in former days, when clergymen were obliged to devote a portion of their time to the cultivation of the soil. It is by no means strange that the vocal apparatus, the most delicate and irritable structure in the body, should give way under the excessive tasks often laid upon it, when there is a general debility and want of tone in the whole muscular tissue. Thus, seamstresses often lose the use of the right hand and arm, from the too constant use of the needle; but stonecutters, who also use the right arm in a still more laborious employment, rarely meet with the same accident; and the reason is to be found in the different degrees of strength and resistance imparted to the system by the different degrees of exercise. Dr. Copland remarks, that over exertion of the vocal organs produces various morbid affections, such as hæmoptysis, laryngeal phthisis, aphonia, œdema of the glottis, functional, and, subsequently, organic diseases of the heart and large vessels; and lastly, nervous and cerebral affections. He believes, however, that the ill effects from this cause are not so great nor so frequent as some writers have stated, and that much of the mischief is referable rather to the enthusiasm of singers and orators, to the passions which are called up during the exercise of their powers, and to the various dissipations and exposures into which their vocations lead them. Besides orators and public singers, actors, and those who play much on wind instruments, are also subject to diseases of the vocal organs, to pains in the chest, affections of the larynx, œdema of the glottis, pulmonary emphysema, and spitting of blood. It is also a well-known fact that street criers often perish from laryngeal consumption, induced by over exerting the voice. Whenever symptoms of these maladies appear, absolute rest of the vocal organs is indispensable to a cure. Other remedial agents it does not fall within our province to indicate.

The *eye-sight* is often injured among engravers, printers, watchmakers, embroiderers, and painters, by too intense application to minute objects; and among workers at iron forges and furnaces, by the continued or intense action of light.*

* The affections thus induced are amaurosis, cataract, inflammation of retina, iris or capsule of the lens, and short-sightedness, from the increased convexity of the eye, from continued compression by the muscles of the eyeballs.

But the most frequent and important examples of the undue exertion of particular organs, to the neglect of others, occur among students and literary men, in the over working of the brain. The brain, as the material organ of the mind, is subject as regards its exercise, to the same laws as the other organs of the body. It may suffer from inactivity as well as from being over worked; and its functions, the intellectual and moral faculties, acquire strength only by discipline and exercise. It is a remark of Plutarch, that "should the body sue the mind before a court of judicature for damages, it would be found that the mind would prove to have been a ruinous tenant to its landlord." This refers doubtless rather to the influence of the passions and emotions upon the body, than to study and mental application; the former proving far the most injurious. Still, there can be no question but that health is often destroyed and life shortened by intellectual pursuits. This is indeed denied by Dr. Dunglison and some other writers; but daily observation proves that it is a fact. Tissot remarks that the disorders produced by the efforts of the mind fall soonest upon such as are incessantly engaged in the contemplation of the same object. In this case, he adds, there is only one part of the sensorium acted upon, and that is kept always on the stretch; it is not relieved by the action of other parts, and therefore is sooner fatigued and injured. Thus Boerhaave, after a long period of intense study, suffered for six weeks from excitement of the brain bordering on insanity; and even the mind of Sir Isaac Newton was for a considerable time disordered by excessive application, and it is believed he never entirely recovered from the shock. Numerous examples of a similar kind might be given, were it necessary; though we are free to acknowledge that in many of these cases literary pursuits have operated chiefly in a negative manner, by inducing those sedentary habits which in all occupations are so prejudicial to health. Unless there is evident cerebral disorder, we should rather refer such consequences to collateral circumstances than to excitement of the brain. "Men of exalted intellect," says the celebrated Pinel, "perish by their brains, and such is the noble end of those whose genius procures for them that immortality which so many ardently desire." Dr.

James Johnson has remarked, that "a high range of health is probably incompatible with the most vigorous exertion of the mind, and that this last both requires and induces a standard of health somewhat below par. It would not be difficult," he adds, "to show that the majority of those who have left behind them imperishable monuments of their intellectual powers and exertions were people of weak bodily health. Virgil, Horace, Voltaire, Pope, and a thousand others might be quoted in illustration." Dr. Dunglison believes that these are only "coincidences, affording examples of high intellectual attainments and productions, in spite of the bodily infirmities under which those distinguished individuals labored, but by no means showing that they were the consequence of such infirmities. Nothing," he adds, "would seem to be clearer than that full intellectual development requires that the different corporeal functions should be faithfully and regularly executed. It is impossible for the mind to aspire to lofty conceptions, or for the various intellectual faculties to be fully accomplished, unless the body be devoid of suffering. Whatever distracts the mind from its own operations, enfeebles the results; and nothing does this more effectually and unpropitiously than suffering of any kind. It can easily be conceived, however, that although sickness may interfere with the vigorous exercise of the higher faculties, it may yet be the occasion of greater production than a state of health. Disease, or infirm health, necessarily confines the invalid, and hence incites the intellectual exercises for the purpose of dispelling the *ennui* which such a condition induces, and thus the *production* may be greater, although the *capabilities* may be less."

The same writer quotes the opinion of the celebrated philosopher Blumenbach, who asserts that for the half century and more of his connection with one of the most celebrated universities in Europe, he has not known a solitary example of any youth falling a victim to his ardor in the pursuit of intellectual distinction; and of Eichhorn, the eminent philologist and historian, who remarks that "no one ever died of hard study. The idea is preposterous. A man may fret himself to death over his books, or any where else; but literary application would

tend to diffuse cheerfulness, and rather prolong than shorten the life of an infirm man."

"Our experience," says Dr. Dunglison, "is completely in accordance with theirs. We cannot, indeed, recollect a solitary case of serious mischief induced by too great intellectual exercise, although, as has been remarked, the cause has not unfrequently been assigned."

Notwithstanding these very positive opinions, we see no reason to believe that the brain is an exception to all the other bodily organs, and that while they may all be injured by overworking, this complicated and delicate instrument is able successfully to resist the overtasking of its ordinary and peculiar functions. We know that hard students frequently perish of apoplexy, palsy, and other cerebral diseases; and it is not uncommon for orators, as in the case of the late T. A. Emmett, to be struck down while under the influence of intense mental excitement. Who will deny that the life of Sir Walter Scott was shortened by his intellectual pursuits, or that Canning, Davy, Whitbread and Romilly were not injured by the same cause? Doubtless there were other and powerful causes which coöperated: this is not denied: the question is, was not life shortened by too great intellectual efforts? The fact then is, that literary men not only suffer from the ordinary diseases incident to sedentary habits, but also from others dependent on over exertion of the mental faculties. These are melancholy, hypochondriasis, cephalalgia, paralysis, apoplexy, palsy, inflammation of the brain or its membranes, mania, and softening of the brain. These evils, however, it should be recollected, are not unavoidable: they may with great certainty be prevented by moderate diet and regimen, by avoiding excesses of every description, by regular and moderate exercise in the open air, by early rising, by sufficient but not too much sleep, with attention to the digestive organs and to the promotion of the abdominal secretions and excretions. In persons of highly nervous temperament, where the system is unusually impressible, we see, during intense mental action, that a preternatural supply of blood is sent to the brain, often giving rise to headache, confusion of ideas, or a sense of heat and fullness. This excitement, if not too

great, is a source of pleasure to the student or orator, and indeed highly salutary; if carried beyond this point, it may lead to the most fatal results. By proper training, the intellectual powers become capable of astonishing efforts without injuriously affecting the bodily health, and where in connection, due attention is paid to the collateral agencies above mentioned, we can safely promise as great, if not a greater longevity than is attained in ordinary circumstances among those whose habits are laborious but not literary.

But whatever may be the fact in relation to adults, it is now conceded by all physiologists that mental application cannot be practiced by the young with equal impunity. "When study," says a late writer, "is indulged to excess in early life, it may have a tendency to induce a predominance in the nutrition of certain organs at the expense of others. It is well known that if any organ be energetically exercised, its vital activity is exalted, and a larger afflux of blood takes place towards it, so that it attains a greater degree of development than where it is less used. Hence we can conceive that a constant overstraining of the intellectual powers, especially when conjoined with irregularity in exercise, diet, sleep, &c. may occasion augmented flow of blood to the brain, and consequent disease in that viscus even in the adult. Still more likely is this to ensue, if the same application be made before the organs have undergone their full evolution; and hence we may conceive that early and intense study may lay the foundation to faulty development in other parts of the frame, and to great energy of nutrition in the brain."

According to Bichat, it is a fundamental law of the distribution of the vital powers, that when they are increased in one part they are diminished in all the rest of the economy; that the sum is never augmented, but that they are necessarily transported from one organ to another; and therefore, to increase the power of one organ, it is absolutely necessary they should be diminished in others. In infancy or youth, when all the organs and functions are in the greatest degree of growth and activity, and supplied with all their energy by the organ of the mind, how important that this organ should be left to

direct its undivided influence to their support! It has been well observed, that if it were possible to bring intellectual operations into play in the mind of the infant, the brain could not supply the proper nervous power for digestion, assimilation and nutrition, and the whole machine would languish or decay. In proportion also as the brain of a child is tasked, and the nervous energy expended in intellectual exertions, in that degree is the rest of the body weakened, and the whole system predisposed to disease. In precocious children we find the brain unnaturally enlarged, and the whole nervous system developed to that extent as to destroy that equilibrium between the different systems of which the body is composed which is essential to health or comfortable existence. Longevity in such cases would be miraculous. Such children are prematurely cut off by rickets, scrofula, convulsions, inflammation, or dropsy of the brain; or if they live to adult age, they are exposed to insanity, hypochondriasis, diseases of the heart, and dyspepsia. In fact, precocity is merely a symptom of disease, and is to be treated by exercising the muscular system, while the brain is permitted to rest. In this way only may the healthy balance be restored. But it is unnecessary to enlarge on this point. Those who wish to see the subject ably treated, may consult an excellent work of Dr. Brigham's, "On the influence of Mental Cultivation upon Health;" Dr. James Johnson's "Economy of Health;" Spurzheim "On Education;" or the works of George and Andrew Combe. No parent should neglect to inform himself on this very important subject.

The preceding remarks refer particularly to the influence of mental labor, or the exercise of the intellectual faculties, upon health and longevity; but there is a far more commanding and disastrous influence exercised through the passions. As the mind is cultivated, the feelings grow more acute, the sympathies more active, and, in short, the whole moral man more sensitive to moral impressions; and these impressions, as society becomes more artificial, and the imaginary and conventional wants of mankind multiply, grow more numerous and intense. We need but name political excitement and party spirit; the anxieties and struggles of trade and commerce; the jealousies and

rivalries of professions; the suffering, discontent, and despair of poverty; and the strife and hatred of intolerant sectarianism. There is, indeed, no country on the face of the globe where there is greater mental activity than in this. It pervades all classes. It penetrates every region. In our large cities, the spirit of trade seems to predominate. Wealth alone is the test and standard of respectability. A successful speculation is regarded as the surest indication of worth and talent, while a ruinous one stamps the perpetrator as a sad fellow. All the noblest feelings and sentiments of the soul bow to this groveling and debasing love of gain. In such a community there is danger that genius, learning, talent and moral worth will be neglected and depreciated; while ostentation, extravagance, and luxury, the symptoms (too often false ones) of wealth, stamp their possessor with dignity, honor and respect. Who can calculate the amount of mental labor and excitement consequent on the prosecution of these innumerable schemes for getting wealth? Who can tell at what expense of health and comfort and present happiness they are pursued? But lately the whole land was rife with speculations. Every farmer became a land broker, and every jobbing merchant, jobber in general. Excitement has in a measure subsided; disappointed hopes, sullen despair, and ruined health have, in thousands of instances, succeeded to buoyant expectations and certain riches. Insanity, diseases of the heart and nervous system, dyspepsia, and hypochondriasis, are far more prevalent than they were ever known to be before: our lunatic asylums contain numerous victims to this absorbing passion, while many others are in a state bordering on derangement, drowning their reason and their troubles in the Circean cup. "When we walk the streets of large commercial towns," says an able writer, "we can scarcely fail to remark the hurried gait and care-worn features of the well-dressed passengers. Some young men, indeed, we may see with countenances possessing natural cheerfulness and color; but these appearances rarely survive the age of manhood. Cuvier closes an eloquent description of animal existence and change, with the conclusion that 'life is a state of force.' What he would urge in a physical view, we may more strongly urge

in a moral. Civilization has changed our character of mind as well as of body. We live in a state of unnatural excitement: unnatural, because it is partial, irregular and excessive. Our muscles waste for *want* of action; our nervous system is worn out by *excess* of action. Vital energy is drawn from the operations for which nature designed it, and devoted to operations which nature never contemplated. If we cannot adopt the doctrine of a foreign philosopher, 'that a thinking man is a depraved animal,' we may without hesitation affirm that inordinate application of mind, the cares, anxieties and disappointments of commercial life greatly impair the physical powers. The various disorders generally known under the name of indigestion, disorders dependent on a want of circulation of blood through the bowels, biliary derangements, constipation, and headache, are well known to be the general attendants on trade closely pursued. Indeed, in almost every individual this absorbing principle produces one or other of the various maladies to which I have alluded. More marked is the effect when anxiety is added. This greatly reduces the functions of the stomach: it produces flatulency, and often diarrhœa: it sometimes affects even the kidneys: it almost always, when long continued, produces permanent disease of the liver, scirrhus of the stomach: moreover, medullary and fungoid tumors, and other malignant diseases, occur most frequently among the victims of mental depression and care.—The physical evils of commercial life would be considerably reduced, if men reflected that the success of business may be prevented by the very means used to promote it. Excessive anxiety, by disordering the animal economy, weakens the mental powers. Our opinions are affected by states of the body, and our judgment often perverted. If a clear head be necessary in commercial transactions, a healthy state of the body is of the first importance; and a healthy state of body is incompatible with excessive application of mind—the want of exercise and fresh air. But subjects like this find no entry in the books of our merchants. Intent on their avocations, they strangely overlook the means necessary for pursuing them with success. They find, too late, that they have sacrificed the body to the mind. And why this perversion

of nature? Why do we think and toil? To obtain wealth, and thus increase our means of happiness. But will wealth compensate for the evils which attend it? Its acquisition produces—will its possession remove, functional or structural maladies? Will it banish those thousand nervous and hypochondriacal feelings, which produce more misery than even organic disease? And when we have sacrificed health and abbreviated life for the acquisition of property, what happiness have we got in exchange? Every moralist tells us, or rather reminds us, of the insufficiency, the vanity of riches. The subject is trite and hackneyed: the truth is admitted, approved, and forgotten. Nay, the very moralists who most repeatedly urge moderation of our desires, are not always the men to practice the lessons they teach. Seneca gives a receipt for the acquisition of wealth; and this receipt is the reduction of our desires; and in every page of his epistles is a pithy sentence of a similar character. Yet Seneca was the usurer of millions. Could the ancient philosophers rise again, and assemble our youth around them; were Zeno or Epictetus heard in the haunts of commerce, some impression might be made; or were the principles of a greater Teacher impressed on the mind, medical men would have merely to direct, not to enforce."

[For the American Repertory.]

ARCHIMEDEAN SCREW AS A PROPELLER.

In a late number of your journal, the advantages—or rather the disadvantages—of the Archimedean screw, applied as a propeller, were set forth in detail by a correspondent, who, after much investigation, declares, and undertakes to prove, that the objections to this screw are of such magnitude, in a practical point of view, as to render the idea of its introduction too visionary for serious contemplation. He then proceeds to state the "insurmountable" objections against it, all based upon a radical imperfection in the Archimedean screw. And insurmountable he proves them to be, so long as the use of that peculiar form of the spiral wheel is adhered to; for it is easy to understand that a screw possessing a progressive motion of only

seven feet can never be economically driven at the velocity required to impart the necessary speed to a vessel.

But, in view of its manifold defects, so clearly exposed by your correspondent, why may not the Archimedean screw be abandoned, and in its stead a spiral wheel substituted of the same diameter, with two, four, or even *six* flanches or threads traversing a shaft of seven or eight feet in length, at an angle of about 45°? Under this arrangement, although no one thread would complete a turn upon the shaft, a sufficient propelling surface would be presented by all combined, and with a progressive motion at 70 revolutions per minute, of more than ten miles per hour.

As your correspondent does not once consider or advert to an arrangement of this kind, I am induced to inquire, through the pages of your journal, What theoretical or practical difficulties lie in the way of its adoption? W.

Desirous to offer our correspondent, at the earliest moment, a reply to his candid inquiry, we submitted the prominent points of his communication to the author of the article upon Ericsson's Propeller, to which he refers, and have received in return the following remarks.—*Ed. Amer. Reper.*

"Sir—In reply to your correspondent I would observe, that the objections to which he alludes were urged against the *Archimedean screw* applied to the experimental steam-boat Archimedes, and not against a *wheel* with spiral vanes, as he suggests. Such a wheel would in my opinion be far preferable to the Archimedean screw, though not so perfect as the Ericsson Propeller, in which the spiral planes, by being attached to a large hoop, are made to act at a considerable distance from the centre of motion, thereby alleviating the unfavorable action and loss of power attending the small angle, which a great portion of the spiral vanes must make with the line of axis, where they are made to run into the centre in the manner suggested not only by your correspondent, but by a host of inventors both in this country and in Europe.

"As far as I am able to judge, the great distinguishing feature between the Archimedean screw and the Ericsson propeller

is, however, that the former has a very slow *progressive* motion, and consequently must move at a high velocity; whilst the latter has a quick *progressive* motion, and hence moves at a slow speed.

"I am informed that the supporters of the Archimedean screw think the great angle which the thread makes to the axis necessary for effect; whilst Capt. Ericsson prefers the small angle, since that enables him to communicate the power of the steam-engine directly to the propeller, without the intervention of cog-wheels, bands, or other multiplying gear. M."

Silver Plating.—This operation can be performed by two methods:

1. Plates of perfectly pure copper and silver may be united by the process called *sweating;* but if they be alloyed, the result is very uncertain. The operation is performed thus: The surfaces of the metals are first freed from oxide, and sal-ammoniac placed between them; they are then compressed together between iron plates; after which, being placed in the fire, and properly heated, they unite so perfectly that they may be rolled or otherwise worked, either hot or cold, without separating.

2. Irregular shaped copper vessels, such as tea urns, trays, &c. are first cleansed of their oxide in dilute sulphuric acid, then washed with pure water, covered with sal-ammoniac, and tinned: this gives an even surface to the copper. Silver leaf is then laid on, and combines with the tin, from the heat of a soldering iron which is passed over its surface.

Notes at Conversational Meetings, Mechanics' Institute.

Daguerreotype.—A very great improvement in the sensitive coating given to the plates for procuring pictures by the Daguerreotype process has lately been effected, by which the period for keeping the plate in the camera has been reduced to 15 seconds, and made in a great degree independent of the sunlight and clear atmosphere, by which it has hitherto been so much influenced. This improvement results from the use of a mixture of the vapors of iodine and bromine.

NOTICES OF NEW PUBLICATIONS.

Life of De Witt Clinton. By James Renwick, *LL. D. Being No.* 125 *of the Family Library.* New-York: Harper & Brothers. 1841.

We can most cheerfully recommend a perusal of this faithful memoir. The history of our State may truly be called a synopsis of Mr. Clinton's public services: he will ever be held as a pattern both for patriots and philanthropists. His undaunted and unerring spirit has secured to us the appellation of "the Empire State," so well deserved by our commercial advantages, most of which were rendered available by his untiring zeal. This work is illustrated with a Portrait, engraved by Durand from a picture by Inman.

Lives of Eminent Men. Family Library, Nos. 123 *and* 124. 2 vols. New-York: Harper & Brothers. 1841.

Most of these memoirs have been selected from the British Gallery of Portraits, and are well calculated to emulate the youthful reader to high achievements. Illustrated with engravings of Wickliffe and Burke.

PROGRESS OF THE ART OF MINING.

On the Augmentation of the Force of Powder by the admixture of other Bodies. By Mr. Mayer, *Mining Superintendent at Gengenbach, near Offenburg, in the Duchy of Baden.* [Selected from the Mining Review.]

As it may be interesting to such of your readers as are engaged in mining pursuits, to be made acquainted with the various results in different districts, of the method now known for several years of mixing powder with sawdust, in order to obtain increased effect in blasting, I hope it will not be unacceptable to them and to the mining public in general, if I present them the following details of the experiments made in this district; since, by comparing these with other trials, improvements may probably be suggested in the method of procedure:—Our first efforts were directed to ascertain the exact proportion of the sawdust to the powder, in order to obtain the maximum of expansive force; and it was found, after numerous trials, that in some of the mines of this district, where one pound of powder was formerly used to make up six cartridges, now nine cartridges are made up with the mixture. In other mines of the Grand Duchy of Baden, and particularly in my own official district, one pound of powder used to be requisite to fill eight cartridges, but on being mixed with sawdust, one pound of powder was sufficient for twelve cartridges; and afterwards, on our becoming more skilled in the management of the whole process, sixteen cartridges were made from the same quantity—an increase of one-third, and subsequently of one-half in the number of cartridges—the effect being found equal to what could be expected from powder alone, and failures in the blasts not being more frequent than is usually the case in all mines; of this I have been an eye-witness in a very great number of instances.

It has been objected that the additional length of the cartridges would

render it necessary to work a deeper hole in the rock, so that the increased labor required would in part counterbalance the saving of powder; but to this remark I have to reply, that the superior elasticity of the mixture admits of the six-inch cartridge being pressed down by the clay to the length of four inches only, and, consequently, in a hole ten or eleven inches deep, there remain six or seven inches for the clay, which is, beyond doubt, quite sufficient; and it may be observed, that the holes are very seldom worked to a less depth than ten to eleven inches. In some places, however, the mixture has not met with the same approbation; but I am not able to state whether this be owing to a want of correctness and attention in the operations, or to a lurking prejudice against innovation.

The objections which had been brought forward against the sawdust led me to reflect whether some other substance might not be equally efficient, and an incidental circumstance seemed to indicate the very material. Being out with a shooting party, after firing my piece several times, I found myself at a loss for wadding, and, in the hurry of the moment, made use of some envelopes of letters, on which there was a more than ordinary quantity of sealing-wax. I had scarcely pulled the trigger, when I experienced a gratification not generally calculated upon by sportsmen—that of being, in no very gentle manner, extended on the turf—and the pain I felt in the shoulder and head might have made me wish I had postponed the shot till my next excursion, if I had not thought I had made the very discovery of which I was in search, since I naturally attribute the force of the charge to the sealing-wax. On my return home I made some trials, not with the usual component parts of sealing-wax, but with the colophonium (resin) alone. For a bore requiring two ounces of pure powder, I took one and a half ounce, adding the eighth part of an ounce of powdered resin, which was combined with the powder by friction on a sheet of smooth paper, the mixture being indicated as accomplished, when the black color of the powder assumed a yellowish hue from the resin. Being filled into a cartridge for a hole sixteen inches deep and one inch in diameter, bored in a granite block of great hardness, and two and a half feet long, two feet wide, and two and a half feet high, the cartridge occupied three inches, and the remainder was rammed with heavy spar. The explosion was perfect, and the mass burst into four nearly equal pieces, besides several small ones—one of the former being thrown a distance of four paces. Concluding from this excess of force, and from the well grounded report, that less powder would do, I tried, in a similar hole, one oz. of powder to one-sixteenth of an ounce of resin, and I was pleased to find the effect fully equal to what might be expected from two ounces of powder alone.

After these experiments, I found it easy to account for the violent recoil and loud report of my fowling-piece—the resin having produced a more immediate and rapid ignition of the whole mass. It is to be observed, that on using unmixed powder, many of the grains are lost, as is evident from the black streaks discernible after shooting over snow with the gun muzzle near the ground—the piece being held horizontally. These marks or streaks of powder must generally consist of one-half of the charge, but similar appearances are not visible on using the mix-

ture. I was now so fully convinced that this last mixture would effect a saving of one-half of the powder, that I immediately introduced the use of it in these mines, where it has ever since, namely, a year, been used with the same uniform result, and has even been adopted in a colliery, where the managers had previously tried the sawdust without success.

On using this mixture of colophonium, there never occur those (so called) Bichsen, but the whole rock round the hole is sprung from the powder-bag; and, moreover, it is observed, that the blast takes effect in almost every case below or behind the bore in the rock itself.

With regard to the expense of the commonest resin, which is what I use, the value of one ounce of it to one pound of powder is very little; and even the finest resin, at two kreutzers the ounce (about three farthings) saves a pound of powder, which usually costs from 24 to 30 kreutzers (from 8d. to 10d.)

I next made trials with the *semen lycopodii*, which possesses in a high degree the qualities requisite for the immediate combustion of the powder; but I took only one ounce of it to eight ounces of powder, and found it to produce the same effects as the mixture with sawdust or with resin; but as a pound of this seed will suffice to mix with powder for 512 blasts, I consider that its application may be advisable when it can be procured in sufficient quantities.

Extract of a Letter from Dr. BLUMHOF, *Court and Cabinet Councillor of the Grand Duchy of Hesse, to Dr.* KARSTEN, *editor of the "Mining Archives."*

The publication of your journal is a matter of considerable gratification to me, and to many of the lovers of science, on account of the opportunity which it affords of making generally known the results of labors and observations, made at the most various and distant parts of the world. I make this remark more particularly in reference to the report inserted in your "Archives," of the experiments made by Mr. Thürnagel, in Tarnowitz, on the new method of blasting with mixed powder. These trials are highly interesting, and their result completely confirms the similar experiments which have likewise been instituted in this mining district. Immediately upon the appearance of the Brazilian account in the *General German Advertiser*, I commenced a series of similar experiments at the iron mine of Lixfield, near Giessen, of which the following are the results:—

By the new method of mixing, the mining captain was able to fire 32 blasts, from holes of 15 inches deep, in hard rock, with one pound of mining powder; and one ounce of powder mixed with one ounce of fine dry sawdust, from beech wood, had the same effect as if a four ounce cartridge of powder only had been used. In this instance, the saving was three times the amount of the powder used, or 75 per cent. It was found that the sawdust should not be too highly dried, but only to a degree sufficient to drive off the moisture; and only the finer particles were made use of, the rest being separated by means of a sieve. The captain noticed that the explosions of the mixed powder were not so loud as of powder alone, and that this new method was not so appli-

cable to mines which were not well supplied with air, since the mixture produces more smoke, and of a more suffocating nature, than powder alone.

It is my intention to make these experiments in other mines also, and I propose to communicate to you the results obtained. Since writing the above, I noticed an article in the *Nurnberg New Mining Journal*, edited by Mr. Von Moll, in which there is given a description of similar trials with this mixture, by Mr. Selb, Upper Mining Councillor of Wolfach, in the Kinzing-Thal; and as in all probability you have not yet received a copy of the above publication, I take the liberty of giving the substance of his notice in the writer's own words:—"I used common fir-deal sawdust," he observes, "passed through a rather fine sieve, and dried so as to leave no perceptible moisture; this reduced it to nearly half its former weight, yet without altering the color or any other peculiarity. This was added to equal parts of gunpowder, and the cartridges filled in the usual manner, every other preliminary being the same as with powder alone. The effects were such as far to exceed my expectation, whether the blasts were made in the foot or hanging wall, and I consider that nearly double the quantity of powder would have been required, in order to produce an equal force. About thirty charges were fired, and the conclusion derived from them is, that the same mechanical force may be thus obtained with precisely half the quantum of weight and volume; and yet these experiments are hardly commenced, so that it may be presumed that the proportion of powder may be still further diminished, when the theory and the laws by which the force is regulated become better known, and the practical application of it shall consequently be more accurately directed. The discovery of this method will doubtless prove a considerable benefit to the mining interest, and, on the score of economy in so expensive an article, well deserves general adoption."

On Assaying Copper by Electro-Chemical Action. In a Letter to the Editor of the Mining Journal. By MARTYN J. ROBERTS, *F.R.S.E., Cor. Member Royal Geo. Society of Cornwall.*

SIR—I notice in your Journal of the 2d inst. a communication from Mr. R. W. Byers, on a new mode of assaying ores by galvanism, and in which he gives me credit for "the first idea" of this discovery. Now in justice to myself I must state, that not only did I give Mr. Byers the first idea, but a full explanation of this method, my own apparatus for effecting it, and at the same time furnished him with details essential to success in this new process, which he has omitted in his communication; and as the subject is of great practical importance, you will, perhaps, allow me to give an explanation of my method in your valuable and widely circulating periodical.

It may be interesting to such of your readers as are unacquainted with electrical science, to know, in the first place, the cause of the precipitation of copper from its ores—and this I hope to show them.

If we take two metals—one being more easily oxidated than the other—and join them together, either immediately by contact, or medi-

ately, by the interposition of a wire, then plunge them into an acidulated solution (such as dilute sulphuric acid) we have a galvanic pair, acted upon, or excited by the dilute acid; the water of the solution is decomposed, its oxygen combines with the metal most easily rusted (called the "positive pole") while the hydrogen of the water is evolved at the surface of the other metal (called the "negative pole"). Copper and zinc are two such metals. Zinc is more easily attacked by acids than copper, oxidates more rapidly, and, in the above case, is the positive pole; the copper plate, while in connection with the zinc, is the negative pole, and its attraction for the acid is in a great measure annihilated by its contact with the zinc, and is, of course, thus preserved from oxidation; which fact Sir Humphrey Davy made use of in his endeavors to preserve the copper sheathing of ships.

Now, if instead of dilute acid, as the exciting liquid of the galvanic pair, we employ a metallic solution (say sulphate of copper) the zinc plate of the galvanic pair having a greater affinity for the sulphuric acid of the sulphate of copper, than the copper has for the acid which holds it in solution, abstracts and combines with this acid, while the liberated copper is thrown down upon the negative pole, which in this case is a copper plate; but it may be of any metal having less attraction for oxygen than zinc—such as iron, gold, silver, platina, &c.—and it is an axiom in electrical science, that when a metallic solution is acted upon by galvanism, the acid goes to the positive, and the base to the negative pole. Thus, then, we see in what manner the copper is thrown down. But there is a point of great importance which calls for particular explanation, yet, in Mr. Byers's communication, it has been entirely overlooked. I mean the question as to what metal must be employed as an oxidable plate, or positive pole, in a galvanic pair, for the assaying of ores.

When an ore has been dissolved by an acid, we have a metallic solution, not of one metal only, but it may be of several. In the case of most copper ores, there is no doubt but that we should have a solution of iron as well as a solution of copper, and, unless the principle of my process be fully understood, much error may arise. For instance, should zinc be used as a positive plate, the galvanic action would throw down upon the negative pole all metals that have less affinity for oxygen than zinc, and, as iron is one of these, iron would be precipitated on the negative pole, and the result fallacious, as an assay of the quantity of copper in the ore. We must, therefore, be careful in all assays to form our positive pole of that metal which is next in affinity for oxygen to the metal which we wish precipitated on the negative plate, and by adhering to this rule, we may successively discover all the metals contained in the dissolved ore. I shall give an example. I have an ore dissolved which I suspect to contain iron, copper, and silver. The affinity of each of these metals for oxygen stands in the order in which I have placed them—iron having the greatest. To discover what quantity of silver may be in the ore, I form a galvanic pair of a silver and copper plate—the silver being the negative and the copper the positive pole—and immerse it in a measured quantity of the ore in solution. To ascertain the quantity of copper, I take another measured portion of the solution, and immerse in it a galvanic combination of cop-

per for the negative, and iron for the positive pole, for iron being next in affinity for oxygen to the copper sought in the solution, my copper is now thrown down. To find what iron may be contained in the ore, I take another portion of the solution, and in it immerse a galvanic pair, consisting of iron and zinc, (zinc having a greater affinity for acid and oxygen than iron has) and of course the iron in solution would be thrown down on the negative plate.

In addition to, or rather in correction of, the details of these experiments given by Mr. Byers, I should add that, instead of using an unglazed, porous cup, or division between the plates of the galvanic pair, I prefer employing a bladder, because it is more easily obtained by workmen; and, in some cases, there is an objection to porous earthen ware, the metal precipitated being apt to deposit itself in the substance of the ware; but in the tissue of the bladder no such deposit need be apprehended. And, again, it is also far better to avoid the use of mercury, in making the connection between the metals, as described by Mr. Byers; but to make short of a long story, I shall describe the last method—let us say, for discovering copper:—Take a plate of thin copper, bend it in the form of a cylinder two or three inches long, and one or two inches in diameter, open at both ends; make a small hole in the plate near to one end: take a smaller sized cylinder of iron, solder to one end of this cylinder a copper wire (No. 16) 12 or 18 inches long, and let the free end of the wire have a screw thread upon it, with a nut or button to screw on, (there may be a shoulder on the wire at the bottom of the thread as a stop, or, if the wire be larger than the hole made in the copper cylinder, it will answer the same purpose). Now dissolve your ore with the assistance of heat, filter and put the solution in an earthen pot, (a pint jug will answer) then take your positive cylinder, and put it in a small bladder, together, with sufficient dilute sulphuric, or hydrochloric acid, to cover it; then (first having weighed the copper cylinder) put the screw end of the wire soldered to the iron cylinder, into the small hole in the copper cylinder, and screw it tight on by the nut; then place the bladder together with the iron cylinder, inside the copper cylinder, and plunge both into the vessel containing the dissolved ore; when the action has ceased, unscrew the copper cylinder, weigh it, and its accession of weight will show the quantity of copper in the ore.

Such is the simple and efficacious process which I had the honor of describing some years ago at a meeting of the Royal Geological Society of Cornwall, and which was favored with the unqualified approbation of the late Mr. Davis Gilbert, and many other scientific gentlemen who were present. It may, perhaps, have been culpable in me not to have sooner given greater publicity to this mode of assaying, so valuable to the miner for its simplicity and correctness; but I may, perhaps, plead as an excuse a long voyage to a foreign country, and much serious illness. However, we have now to thank Mr. Byers for having brought it forward, although he has not exactly given all the credit due to me. Should any further explanation of my process be deemed necessary, I shall always be happy to give it. It is so very simple that the laboring miner can practice it, and he will, no doubt, find it of great assistance in his takings or settings.

PROGRESS OF SCIENCE.

On Proportions involving Constants. [Selected from the London Surveyor, Engineer and Architect.]

Every one who knows any thing about the very simple but very beautiful and useful doctrine of proportion, is of course aware that when any proposed result is a stipulated quantity of work to be done, the product of the time and power, each estimated in some known unit, expresses the value or quantity of the work; as, for example, a certain labor to be done requires the power of a certain number of men or of horses, for a certain number of days or hours, and the product of these numbers expresses the value of the work in the number of days or hours of a single man, or horse, necessary for the performance of it. When the number expressing the power and that expressing the time are equal to each other, the effect is numerically the greatest possible. Thus, for instance, 12 men in 12 days do more work than 11 men in 13 days; these, again, more than 10 men in 14 days; these more than 9 men in 15; and so on; the effects for the numbers stated above being, respectively, 144, 143, 140, 135—the differences being the series of the odd numbers, 1, 3, 5, &c.

Hence, it is easy to understand that, if the effect is to be the same in two cases, and either the power or the time different, the time answering to any power, or the power answering to any time, may at once be found by dividing the product of the power and time, in the case where both are given, by the power or time which is given in the other case.

There is, however, one form under which this problem sometimes presents itself, which is a little puzzling to those who are not familiar with the doctrine of ratios; and as the management of it is a very easy matter, though, so far as we know, not mentioned in any of the elementary books, we may give a short explanation of it. This will be best done by putting a case:—A certain mine requires to be cleared of an influx of water, which is constant at all seasons of the year; it has been twice neglected, and allowed to fill; and, in the first instance, a power of 8 horses cleared it in 12 hours; while in the second instance, a power of 9 horses cleared it in 10 hours. It is required to know what power will keep the mine dry, and what power is requisite for simply discharging the accumulated water which fills it, without any reference to the influx?

By the conditions, a power of 8 horses for 12 hours, and a power of 9 horses for 10 hours, both empty the mine of the accumulated water and influx. The product in the first case is 96, and that in the second case is 90, the difference of which is 6, that is, 6 hours work of 1 horse power. The difference of the times of emptying is 2 hours; and as 6 hours more work is required for these two hours, it follows that as much water flows into the mine in 2 hours as 6 horses for 1 hour can discharge; consequently, the power required to discharge in 1 hour the water which flows in in 1 hour is that of 3 horses, or, in other words, a 3 horse power would keep the mine clear of water, on the supposition that none were accumulated.

Reviewing the steps of this analysis, we find that they involve this very simple rule: Multiply each power by its time; divide the difference of the products by the difference of the times; and the quotient will be the constant power requisite to perform the constant work.

To know the power which discharges the accumulation, subtract the constant power from each of the given powers, and the remainder in each case will be the power which discharges the accumulated quantity in the time specified in that case. Thus, in the instance which we have given, if 3 is subtracted from 8 and from 9, the remainders are 5 and 6; and as 5 answers to 12 hours in time, and 6 to 10 hours in time, and the product is in both cases 60, which shows that the powers, cleared of the constant 3, are true proportionals to their respective times; and that the pit, without taking the influx into account, can be cleared of water by 60 hours of 1 horse power, or in a single hour by a power of 60 horses, which in effect is just the same.

On the Cause of Scurvy, and the means of Curing it. By GEORGE BUDD, *F. R. S., Fellow of Caius College, Cambridge, and Physician to the Seamen's Hospital, "Dreadnought."*

[CONTINUED FROM PAGE 56.]

All the substances which I have mentioned as preventives of scurvy are derived from the vegetable kingdom; and, it is probable that anti-scorbutic properties are possessed, exclusively, by substances of vegetable origin. These properties exist in very different degrees in different classes of vegetables and fruit; but, in the lowest degree, if at all, in those which are farinaceous. Fresh leavened bread has, indeed been supposed to be highly anti-scorbutic, and has, in consequence, been recommended by many writers on scurvy. But the good effects ascribed to its use have been witnessed in sailors on their return from a long voyage, who were supplied, not only with bread, but also with vegetables, the efficacy of which was probably not duly appreciated. The anti-scorbutic properties ascribed to bread seem incompatible with the fact, of which I could bring many proofs, that scurvy may occur in persons with whom bread forms the main article of subsistence.

Fresh Meat.—The belief that scurvy arises from the use of salt, led to the opinion that it may be prevented or cured by fresh meat. I have already stated that this opinion is erroneous: it is, however, still held by persons by whom it is very important that correct notions on this subject should be entertained. I have known the most fatal effects result from the false ideas of captains of merchant vessels on this point. During the course of the present year, the captain of a vessel trading to the Mauritius furnished his men, while they staid at the island, with a plentiful supply of fresh beef, which being imported from Madagascar, is procured at considerable expense; but he neglected to provide them with vegetables or fruits, which abound in the island, and are sold at a price scarcely worth naming. The consequence was, that scurvy broke out soon after they set sail; and before the vessel arrived in this country, one half of the men before the mast had died of it, and the rest were totally disabled.

Symptoms of Scurvy.—The first indication of the approach of scurvy is generally a change in the complexion, which loses its healthy tint, and becomes pale, slightly sallow, and dusky. This change is attended with lowness of spirits, and with aversion to any kind of exercise, which quickly induces fatigue: and the sailor complains of pains, especially in the legs and loins, like those produced by over exertion.

The gums soon become sore, and bleed on the slightest touch. On examination, they are found to be swelled and spongy, and of a dark red color, especially at their edges, where they are in contact with the teeth.

Purple spots appear on the skin, particularly of the legs and thighs, but often also on the arms or trunk. These spots, which are sometimes very numerous, are generally small and circular, resembling flea-bites; but often, especially when the disease is a little advanced, we meet with other spots as large as the palm of the hand. sometimes much larger, in which the skin is of a variegated violet and green tint, and which resemble, in every respect, the marks produced by a severe bruise. These bruise-like marks occur without the infliction of any blow, or at least, of one sufficient to attract the sailor's attention, and often surround an old scar, or appear on a part which a long time previously has been the seat of some injury.

Another symptom indicative of scurvy is a swelling of the calf or ham of one or both legs, which causes stiffness and contraction of the knee-joint. The parts which are thus swelled, are painful when pressed or moved, and are exceedingly hard, so that they do not yield to the pressure of the finger. The skin covering them is thickened and adherent to the parts beneath, from which a fold of it cannot be pinched up: it sometimes retains its natural color, but more commonly presents the appearance of a bruise.

In advanced stages of the disease, the complexion has a more dingy and somewhat brownish hue; the gums are more swelled and more livid, forming, in some cases, a black spongy mass, which completely covers the teeth; the teeth themselves become loose and frequently drop out; and the debility is such, that the slightest exertion, even the erect posture causes breathlessness and palpitation, and not unfrequently an alarming faintness.

Treatment.—After the details into which I have entered respecting the cause and the prevention of scurvy, little remains to be said of its treatment. The essential point is to give, in sufficient quantity, those articles of vegetable food, which have been distinguished for their anti-scorbutic qualities. Oranges, lemons, or fruits of that class, if they can be procured, should be preferred. The salutary effect of them is extraordinary, and such as would scarcely be imagined by persons who have not witnessed it.

If the state of the gums be such as to prevent the patient from masticating, he should be kept for two or three days on milk diet or on soups, in addition to the anti-scorbutics; at the end of this time, or at the commencement, if the case be less severe, his diet should consist of fresh animal food and vegetables, especially in the form of salads; and as long as he continues very feeble, wine, porter or ale should be given him.

This is all the treatment required for the cure of scurvy.

Bleeding should never be had recourse to, although feverishness or severe pain may seem to render it advisable. It always produces ill effects, and, in advanced stages of the disease, persons do not survive it.

Blisters are apt, in scorbutic persons, to produce mortification, and for this reason we should abstain from their employment.

Mercury, in every form, should be scrupulously avoided. In every instance it aggravates the disease; and very small quantities have been known to produce a dangerous salivation.

The points which I have endeavored to establish in the preceding pages, are—

1st. That scurvy, which, for a long time has been almost unknown in the navy, is still very common in the merchant ships of this country—especially in those trading with the Mauritius, Australia, China and the different ports of India.

2. That the symptoms by which this disease may be recognized are—a pale, sallow, dusky complexion; a listless, desponding manner; swelled and spongy gums, of a dark red color, and apt to bleed on the slightest touch; purple spots and bruise-like marks, particularly on the legs; and swelling and hardness of the calf or ham, with stiffness and contraction of the knee-joint.

3. That scurvy is not attributable to the use of salt meat, to sea air, or to any marine agency, but that it is occasioned by prolonged abstinence from any succulent vegetables or fruits, or their preserved juices, as an article of food; and that by the use of these it may be prevented or cured.

4. That probably all succulent vegetables and fruits, which are wholesome, are more or less anti-scorbutic; and that generally those which are the most succulent are the most efficacious.

5. That the anti-scorbutic property resides in the juices of the plant, and that it is in some degree impaired by the action of a strong heat; and therefore,

That the juices of fruits, as lemons, limes, apples, for sea use, should be kept good by the addition of a certain proportion of spirit, without the aid of heat:

That vegetables, for the same purpose, should be preserved in the form of pickles, as in the preparation of *sour-krout*.

6. That no vessel should be sent on a voyage of several months' duration, without a supply of lemon or lime-juice: and that on the arrival of a vessel in port after a long voyage, the captain should, if possible, provide his men with fresh succulent vegetables or fruits.

As in a subject like the present, particular examples are more impressive than general statements, I have subjoined the details of a case which occurred during the course of the past year. This case is certainly the worst I have ever met with; but I have chosen it, not on that account, but from its being well adapted to show the circumstances which have the chief influence in producing scurvy.

A vessel sailed from England on the 26th of August, and arrived at the Mauritius on the 1st of December; she again set sail for England on the 17th of the January following, and entered the port of London on the 1st of June. The crew were healthy when they left the Mauritius, and consisted of sixteen persons, of whom eight were before the

mast, and formed one mess; the cook, carpenter, second mate and boatswain, another mess; the captain, the first mate, the owner's nephew, (a boy) and the steward, formed the remainder of the crew. Of the eight men before the mast, four died during the passage home, one near St. Helena, of dysentery, and three, after passing the line, before their arrival in this country, of scurvy. Of the remaining four, three were brought to the Dreadnought soon after they arrived in port, the fourth was taken to his friends: all these were in a dreadful condition from scurvy; but they all recovered, with the exception of one who died soon after he was brought to the Dreadnought. Of the four who formed the second mess, one was brought to the Dreadnought, the others went to their homes: all were in a very bad condition. Scurvy showed itself in these men about six or seven weeks after they left the Mauritius, and all of them, except two, had been confined to their hammocks since the latter part of April: of these two, one had been confined to his hammock only ten days; the other, though incapable of doing duty, continued to crawl about until they arrived in port. For ten days before their arrival, the vessel was worked entirely by the captain, steward, first mate, and boy, who messed together in the captain's cabin, and continued free from scurvy. The weather, during the voyage homeward, was fine; the vessel, a good one; and the work of the men before they became affected with scurvy, was not severe. Their diet, after they left the Mauritius, consisted of salt beef or pork, with biscuit, and tea, for breakfast; beef two days, and pork one day, alternately, with biscuit for dinner; and during the first half of the voyage, flour, in puddings, twice a week, and pea soup twice a week. One glass of grog was given daily to each man nearly all the passage. They had no vinegar, lemon or lime juice. The salt provisions were of bad quality, but not of the worst; and the diet was as good in every respect in coming home as in going out, yet none of the crew showed any symptoms of scurvy in their passage outward. While in the Mauritius, each man had two pounds of fresh beef daily, but no fruits or vegetables of any description.

The severity of the disease in this instance must be ascribed solely to *complete* and *prolonged* abstinence from vegetable juices. From the time of their leaving England, the men had been without vinegar, lemon or lime juice; and during their stay at the Mauritius, they had no fresh vegetables or fruits of any kind. In other respects they were favorably circumstanced. They left this country in autumn—the best season, as regards scurvy, for the commencement of a long voyage; their vessel was a good one; and, during the early part of the voyage homeward, the weather was fine, and their work easy. The salt provisions were indeed of bad quality, but all the men agreed that they had met with worse; and in addition to the salt meat and biscuit, they had flour twice a week, pea soup twice a week, and a daily allowance of grog. It is worthy of remark that none of the men exhibited symptoms of scurvy in their passage out, which lasted between three and four months, yet all of them became affected with it in less than two months after they left the Mauritius, although the provisions were quite as good when they were returning as when they were going there, and during their stay at the island, they had been abundantly supplied with

fresh animal food. This is explained by the circumstance that to produce scurvy there must be abstinence from vegetable juices, and this abstinence must be prolonged. Fresh animal food has, as I have before remarked, very little effect, either in preventing or curing it; and, consequently, the time they staid at the Mauritius may be considered as so much time spent at sea.

I have since met with an instance in which the crew of a vessel, likewise from the Mauritius, were reduced by scurvy to a condition almost as bad as in the case of which I have given the details. In both instances the disease was owing, in part, to the want of lemon or lime juice during the voyage: in part, to the circumstance that while they remained at Mauritius they were unprovided with fresh vegetables or fruits.

Among the remedies for scurvy enumerated in the foregoing article, no mention is made of sugar, although this substance we believe is generally conceded by physicians to be an anti-scorbutic. We find in Porter's work upon the culture and manufacture of sugar a case quoted, in which that article was found singularly efficacious in restoring to health a ship's crew that had been seized with scurvy:—"A vessel came from the West Indies heavily laden with sugar. A calm, that had not been foreseen, prolonged the passage till all their provisions were exhausted. The sugar was the only resource left to the crew; and nourished by it, they at length arrived safely in port. Some sailors had died of scurvy during the voyage, and many were threatened with death from the same cruel malady. The scurvy ceased when its victims were from necessity reduced to the sugar diet, and the remedy was at the same time an agreeable aliment."—(*La Gazette de Santé*, No. XLIV, 1785.)

On the Electricity and Explosive Force of Steam, and on the Economy of the Hot-blast Furnace. By HENRY MEIKLE, *Esq.* [Communicated for the New Edinburgh Philosophical Journal, by the author.]

Much curiosity has lately been excited by the electrical phenomenon observed in the condensation of the steam which escaped from a high-pressure boiler at Cramlington colliery, near Newcastle, and which was briefly this: The engine man, when happening to be standing where the steam, issuing from a leaky joint, was condensing into a cloud about his legs, put his hand to the lever of the safety-valve, and instantly experienced an electrical shock. Scientific men, on examining this phenomenon, as detailed in the *Philosophical Magazine* for November last, found the electricity so evolved to be positive; but it is curious to ob-

serve how inaccurately in other respects they have expressed themselves regarding the phenomenon, calling it "the rapid production of electricity which appears to accompany the generation of steam," "the evolution of electricity by vaporization," and "the evolution of electricity during the conversion of water into vapor;" whereas the electricity was evidently evolved by a process just the very reverse, viz. by the sudden change of transparent steam into water; for a cloud just consists of minute drops of water. The novelty in this case seems, after all, to consist chiefly in the intensity of the electricity; for the evolution of positive electricity, when transparent aqueous vapor suddenly assumes the form of a cloud, had been so often observed before, as to leave little doubt that it will be found to hold universally, when once adequate means have been devised for detecting it; and conversely, that steam, instead of evolving electricity at its formation, must then absorb it as a necessary and constituent ingredient. Dr. Faraday thinks the case observed at the Cramlington colliery "brings us much nearer to the electrical phenomena of volcanos, water-spouts, and thunder-storms, than before;" but not nearer, I presume, than Mr. Espy's new theory (which, as noticed in the last number of this Journal, I had published near a dozen years ago) does; because it just refers these phenomena to the evolution of electricity by the sudden condensation of aqueous vapor.

Water requires a higher temperature to make it boil in a glass vessel than in one of metal; and in the former, too, it boils more violently, probably because the glass, being a bad conductor, cannot so well supply the electricity for the formation of steam. When, therefore, the lower part of a steam boiler becomes incrusted with a bad conductor of electricity, the temperature may be raised till the water boil so violently, especially under the feeble pressure of the imperfectly formed steam, as to reach the upper parts of the boiler, which, having little or no incrustation, may then supply the electricity so suddenly to the water and steam already at a high temperature, as to increase the force of the steam to a degree which occasions a violent explosion before there is time for the safety-valve being acted on, or giving sufficient vent for the steam. But this I only mention as one of the various causes to which explosions may be ascribed.

Since air, whilst it expands by having its temperature raised under a constant pressure, absorbs a considerable portion of latent heat, and still more if the pressure be decreasing, it probably also at same time, like steam, absorbs a corresponding portion of electricity. Now, I presume it is on this principle that we are to seek for an explanation of the economy of the hot-blast furnace. When cold and compressed air is forcibly injected into the fire, the fuel and bricks, being generally bad conductors of electricity, cannot supply it with sufficient promptitude or quantity both for the expansion of the air and for the formation of the gaseous products of the combustion. Hence, the process proceeds more anguidly than when the air has been previously heated, and supplied with a corresponding share of electricity.

THE PORTABLE TELEGRAPH.

The great utility of a code of signals on some economical plan, like the following, to be used at short distances, has induced us to republish them from a little work, entitled "*The Homograph, or Every Man a Signal Tower,*" by Lieutenant James Spratt, R. N., for which we are indebted to a friendly correspondent.

Lieutenant Spratt says this new, easy, and useful code of numerical signals is to be performed with a white pocket handkerchief, to be held in different positions with the body.

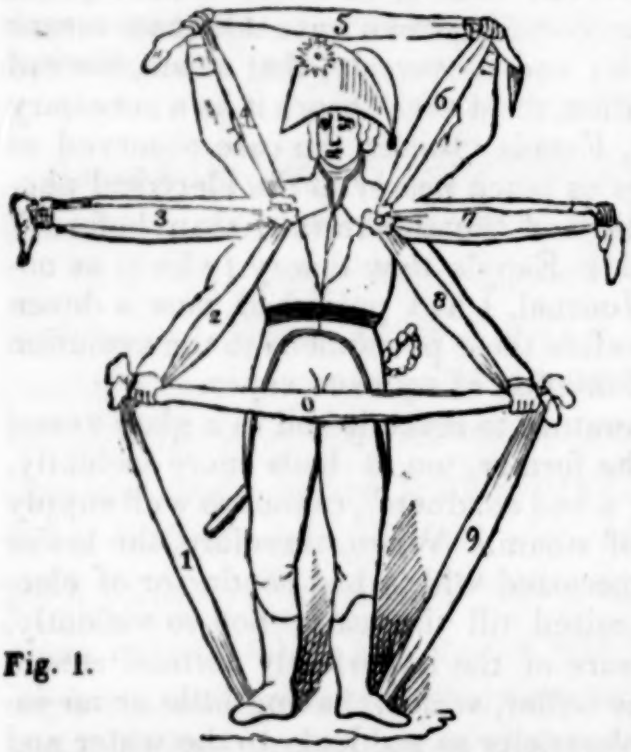


Fig. 1.

Fig. 1, with the additional arms, exhibits the whole of the numerical Homograph signals at one view. (See position that the handkerchief is held in, and the figures thereon.) The first position from the right foot to the right hand is No. 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. When making 1, 5, 9 and 0, the handkerchief should be held by the diagonal corners, as generally prepared for wearing round the neck. For making 2, 3, 4, 6, 7, 8, you should gather the opposite sides of the handkerchief in each hand, the near extremity of the handkerchief to be held by one hand to the point of the shoulder.

In working the Homograph, the body should be erect, the positions steady, the handkerchief to be held well in front of the arms, and parallel to the person to whom you are to impart your intentions. The best place for showing signals from a ship is in the chains, or on a lower deck port, as the white handkerchief exhibits a greater contrast with the black sides, and is of course better discerned: when made from the shore, on the side of a green hill, or in front of some thick foliage, or hedge, or a dark wall. The positions which you intend should compose the number of your signals should be made in succession. The person to whom a signal is made should wave his handkerchief, horizontally, to convince you that it is understood. When the positions which compose the number of your signals are finished, you are to wave your handkerchief in like manner. For example, persons who make use of the Homograph, should arrange in their separate books every question and answer which may occur to them on any subject, as there is no limitation to the numbers. If the number prefixed to your communication be 1000, you are first to make position No. 1, and keep it so, until your consort answers it, by waving his handkerchief, which informs you that it is understood; then you are to make the 0 three times distinctly, (see Fig. 1, for the positions;) each 0 to be kept up until answered as before. Now your signal being made, you wave

your handkerchief, which informs your consort that he is to refer to his book for the purport of the signal No. 1000.—*See Examples.*

It is to be understood that the persons who use the Homograph signals are to have their conversation premeditated, and inserted in separate books, and the sentences to be numbered as in the subjoined examples, when each, by reference to his book, may carry on the conversation at the distance of four miles by a common telescope.

Fig. 2.

Fig. 3.

The author frequently conversed with his messmates at Spithead, from the green ramparts at Portsmouth, and from Plymouth Sound to the Hoe, which is still a greater distance.

When you wish to commence signalizing (if I may be allowed the expression) you are to display the handkerchief, which is called the signal of attention (see Fig. 2); and your consort is to display his in return. The person who displays first has a right to commence signalizing; and to prevent confusion, it is to be displayed at the commencement of every signal.

Fig. 4.

If by any accident your attention should be called off, and you do not comprehend the whole of a signal, by holding the handkerchief as in Fig. 3, you may demand a repetition. This signal is called the repeat.

Fig. 4 shows the following signals, by twisting the handkerchief regularly round the arms :—

No. 1. Affirmative.
2. Negative.
3. Interrogative.
4. To annul.

The Homograph may be found useful to captains lodging on shore, by which they may communicate any or-

ders, with ease and accuracy, to the commanding officers of their ships at anchor.

Passengers in the East and West India and other fleets, may keep up a constant and friendly intercourse, to console themselves for the tediousness of a long voyage.

The country gentleman may, at a moment's warning, summon his neighbors to the sports of the field, or to the hospitable board.

EXAMPLES OF SIGNALS.

1.—We are now going into action; and hope it may end as gloriously as that of Trafalgar.
2.—We have gained a complete victory.
3.—Guard well the prisoners, as they are ten times our number.
4.—Our gallant chief has been ennobled by our gracious sovereign for his services.
5.—The officers who signalized themselves are to be presented with medals.
6.—As you are going to England to refit, I shall be obliged to you for your live stock.
7.—Be particular in boarding ships subject to quarantine.
8.—We are in great distress for provisions.
9.—We are in a very leaky state; relieve us, or we perish.
10.—Our foraging party has been successful.
11.—We have put the enemy's outposts to flight, and made some prisoners.
12.—The enemy's cavalry are advancing from the wood on the right.
13.—We are in need of a reinforcement, with a field-piece.
14.—The enemy is disposed for battle; their wings are strong, and their centre weak.
15.—The engagement is general throughout the line.
16.—Our left is considerably weakened, and the enemy preparing to outflank us.
17.—The enemy are routed on their right; their centre is in great disorder.
18.—Let the cavalry follow the fugitives.
19.—The enemy has been reinforced, and taken possession of a strong post by the sea-side.
20.—The coöperation of the navy will be necessary.
21.—Will you breakfast with me tomorrow?
22.—Shall we keep company?
23.—Send for your letters.
100.—What water have you on board?
200.—I invite you and your neighbors to celebrate the anniversary of the battle of Trafalgar.
1000.—I intend to shake a noble bag fox tomorrow. Meet me at day-break on the downs.

PROGRESS OF FINE ARTS.

Brief Observations on the State of the Arts in Italy, with a short account of Cameo-cutting, Mosaic Work, Pietra Dura, and also of some of the Domestic Arts and Mechanical Contrivances of the Italians. By CHARLES H. WILSON, *Esq. Architect, Edinburgh, A. R. S. A., and M. S. A.* [Read before the Society of Arts for Scotland, and communicated by it to the Ed. New Phil. Jour.]

I feel that I ought to apologize to the Society for bringing before it a paper of this nature, which contains no description of any new art or discovery, but which may be described as being little more than a *catalogue* of arts and practices, most of which are of great antiquity. I hope that such a paper may be deemed admissible. As far as my individual opinion goes, I would say that it would be very desirable if

several papers were read every session, containing as distinct accounts as could be obtained of the state of the arts and sciences, with reviews of the progress made in them in different continental countries every year. That such papers would be useful in various points of view, appears to me sufficiently obvious: those who have neither leisure nor opportunity to inquire for themselves, would by this means obtain a great deal of valuable and interesting information; our efforts to excel in the arts and sciences would be stimulated; and, above all, I think that, whilst our national vanity would be advantageously chastened, feelings of respect and esteem, founded on a knowledge and just appreciation of the merits of other nations, would beyond all other influences lead to international amity. Feelings like these have already been happily nourished by the amicable intercourse of literati of different nations: the course which I advocate would tend to the further diffusion of such sentiments amongst all classes.

I cannot without presumption imagine for a moment that the paper which I now bring before you can deserve to be considered one of such a series. I went abroad at a very early age, and my time was entirely given up to the study of the art to which I had devoted myself, and which every thing around me tended to increase my love of. The collateral studies of the youthful artist are naturally those connected with his art, and are greatly more extensive in Italy, from many favorable circumstances, than in Scotland, and the brief allusion which I have made to them and to the time of life when I lived abroad, is meant as an apology for the meagreness of the details which I humbly bring under your notice.

Any comment on the political condition of Italy would be out of place in a paper to be read here, although a distinct apprehension of it would be necessary previously to any inquiry into the state of her arts and sciences, and also to enable us justly to appreciate the great merits of those Italian philosophers and literati, who, despite of adverse circumstances, so greatly distinguish themselves. To so slight a sketch of the *arts* of Italy as that I am about to offer, any lengthened observations are not so necessary. Whatever may be our opinion of Austrian principles of government, and of Austrian influence in Italy, all who have visited the Italian territories of that power, must, I think, acknowledge that Lombardy is greatly in advance of the independent states, and in no part of Europe, Scotland excepted, are there more numerous schools for the instruction of all classes of the people. As the traveler advances southward, with nominal independence political degradation increases, and the general character of the people is lowered. We can feel no other emotions than those of regret for the prostration of Italy; but if we examine into the customs of the Italians, we shall every where find expressive indications of ancient power and refinement, and pleasing proof that, where civilization and its attendant sciences and arts has once held extensive sway, advantages are secured of which it is almost impossible, or at any rate very difficult, to deprive a people.

I shall commence with a brief notice of the art of painting in Italy. This fine art has gradually declined, and there seems to be no indication at present of its recovery. It is trammeled by academic system. The Roman school is distinguished by a cold affectation of classic purity, and

a want of energy and nature in all its productions; but, whilst we avoid the errors into which it has fallen, we should not allow these, and the difference of its practice from our own, to blind us to its good qualities. Many Roman artists draw exceedingly well, and they evince this power in the large and fine cartoons which they are in the habit of executing before commencing a picture. But if the student in this country does not draw long enough, which I think is the case, the Italian student, in acquiring his mastery of the crayon, seems to forget that he is ever to use the brush; and the Italian artists rarely prove even tolerable colorists, whilst their prejudices as to the adoption of many necessary processes in painting, and which were unquestionably in use amongst their great predecessors, are invincible. This was illustrated in an amusing manner one day in the Florence Gallery. An Italian artist was busy copying a Venetian picture, and my late friend Mr. James Irvine, happening to look at his work, remarked to him that he never could hope to imitate the brilliancy of the original without glazing. "I know that," said the Italian, "but I won't glaze."

At Florence, painting is in much the same state as at Rome: of late some artists have endeavored to add richness in color to the correctness of their drawing; but they have only succeeded in arranging on their pictures in brilliant juxtaposition rainbow colors, without attaining that harmonious effect which marks the works of their great predecessors. At Naples, painting is at a low ebb; at Genoa, lower still; at Venice, it is little better; but at Milan it reckons amongst its professors clever men in some departments of the art.

Fresco painting is still pursued in Italy, but with most success by the Germans. I wish to avail myself of this occasion to do homage to the extraordinary merits of the masters of this distinguished school: in looking on their works, we cannot but regret that greater encouragement is not given to the highest department of painting in this country; in those which are encouraged, our artists excel; and we may, I think, therefore justly conclude that ability would soon be found to execute works of the noblest description.

Engraving may appropriately be considered after painting. You are all doubtless well acquainted with the great names which have lately marked the progress of this art in Italy: most of these distinguished artists are now dead. Several of Raphael Morghen's pupils are much esteemed, the best of whom are established at Milan: many very fine and important works have been lately finished or are now in progress. Messrs. Ludwig Gruner and Rusweigh, both Italianized Germans, promise to revive the style of Marc Antonio with success.

The Italian engravers are most successful in their works from historical pictures; but a practice which they follow is, in my opinion, calculated to prevent their imitating with fidelity the style and feeling of the artist whose production they copy. They engrave from highly finished chalk drawings copied from pictures by artists who devote themselves to this branch: however faithfully these may apparently copy, it is certain that their drawings will, to a certain extent, exhibit their peculiarities of mind and feeling, and as the engraving must likewise so far be marked by the style of its author, the process is not favorable to the production of engravings of a faithful character.

It is but fair to mention that this practice is forced upon the Italian engraver, as he can neither transport gallery pictures nor frescoes to his study.

The landscape engravers of Italy are not successful. Frigid imitators of Woollet, in general their works are far inferior to those of that admirable master.

Sculpture is certainly the art which stands highest in Italy. Canova rescued it from the infamy into which it had sunk, and his genius at once raised it to excellence. If I say that that immortal artist has worthy successors amongst his countrymen, I express as strongly as possible a favorable opinion of the state of the art. If we are to term that the Roman school of sculpture which reckons amongst its professors all the great sculptors of various nations who make the Eternal City their fixed place of residence, then we must, I think, hold that it is the first school existing. England is worthily represented in that united school. I shall not venture upon any comparison between it and our present British school; but it is an important fact, and to its honor, that before Canova resuscitated sculpture in Italy, England could boast a succession of very eminent sculptors. I may mention the estimation in which our great Flaxman is held in Italy. "Flaxman," said a distinguished artist to me on one occasion, "was the greatest sculptor the world has known since the time of the Greeks;" and this opinion is very general in Italy. I touched shortly on the state of painting in the different Italian capitals. I shall pursue the same course with sculpture, but more briefly still, merely remarking that, with one or two exceptions, there are no Italian sculptors of eminence out of Rome.

In connection with the arts of painting and sculpture, we may now consider mosaic work and cameo-cutting as practiced in Rome. The art of mosaic work has been known in Rome since the days of the republic. The severe rulers of that period forbade the introduction of foreign marbles, and the republican mosaics are all in black and white. Under the empire the art was greatly improved, and not merely by the introduction of marbles of various colors, but by the invention of artificial stones, termed by the Italians *smalti*, which can be made of every variety of tint.

This art was never entirely lost. On the introduction of pictures into Christian temples, they were first made of mosaic; remaining specimens of these are rude, but profoundly interesting in a historical point of view. When art was restored in Italy, mosaic also was improved, but it attained its greatest perfection in the last and present century. Roman mosaic, as now practiced, may be described as being the production of pictures by connecting together numerous minute pieces of colored marble or artificial stones; these are attached to a ground of copper by means of a strong cement of gum mastic and other materials, and are afterwards ground and polished as a stone would be to a perfectly level surface; by this art not only are ornaments made on a small scale, but pictures of the largest size are copied. In former times the largest cupolas of churches, and not unfrequently the entire walls, were incrusted with mosaic. The most remarkable modern works are the copies which have been executed of some of the most important works of the great masters for the altars in St. Peter's. These are in every

respect perfect imitations of the originals; and when the originals, in spite of every care, must change and perish, these mosaics will still convey to distant ages a perfect idea of the triumphs of art achieved in the 15th century. The government manufactory in Rome occupies the apartments in the Vatican which were used as offices of the Inquisition. No copies are now made, but cases of *smalti* are shown, containing, it is said, 18,000 different tints. Twenty years were employed in making one of the copies I have mentioned. The pieces of mosaic vary in size from an eighth to a sixteenth of an inch, and eleven men were employed for that time on each picture.

A great improvement was introduced into the art in 1775, by the Signor Raffaelli, who thought of preparing the *smalti* in what may be termed fine threads. The pastes or *smalti* are manufactured at Venice in the shape of crayons, or like sticks of sealing-wax, and are afterwards drawn out by the workman at a blowpipe into the thickness he requires, often almost to a hair, and now seldom thicker than the finest grass stalk. For tables and large articles, of course, the pieces are thicker; but the beauty of the workmanship, the soft gradation of the tints, and the cost, depend upon the minuteness of the pieces, and the skill displayed by the artist. A ruin, a group of flowers or figures, will employ a good artist about two months when only two inches square, and a specimen of such a description costs from £5 to £20, according to the execution; a landscape, 6 inches by 4, would require eighteen months, and would cost from £40 to £50. This will strike you as no adequate remuneration for the time bestowed. The finest ornaments for a lady, consisting of necklace, earrings, and brooch, cost £40. For a picture of Paestum, 8 feet long and 20 inches broad, on which four men were occupied for three years, £1000 sterling was asked.

I shall now notice the mosaic work of Florence, before touching on cameo-cutting. It differs entirely from Roman mosaic, being composed of stones inserted in comparatively large masses; it is called work in *pietra dura*. The stones used are all more or less of a rare and precious nature. In old specimens the most beautiful works are those in which the designs are of an arabesque character. The most remarkable specimen of this description of pietra dura, is an octagonal table in the *Gabinetto di Baroccio*, in the Florence Gallery. It is valued at £20,000 sterling, and was commenced in 1623 by Jacopo Datelli, from designs by Ligozzi: 22 artists worked upon it without interruption till it was terminated in the year 1649. Attempts at landscapes and the imitation of natural objects were usually failures in former times—mere works of labor, which did not attain their object; but of late, works have been produced in this art in which are represented groups of flowers and fruit, vases, musical instruments, and other compatible objects, with a truth and beauty which excite the utmost admiration and surprise. These pictures in stone are however enormously expensive, and can only be seen in the palaces of the great. Two tables in the Palazzo Pitti are valued at £7000, and this price is by no means excessive. These are of modern design, on a ground of porphyry, and ten men were employed for four years on one of them, and a spot is pointed out, not more than three inches square, on which a man had worked for ten months. But Florentine mosaic, like that of Rome, is not merely used

for cabinet tables or other ornamental articles; the walls of the spacious chapel which is used as the burial place of the reigning family at Florence are lined with pietra dura, realizing the gem-incrusted halls of the Arabian tales. Roman mosaic, as we have seen, is of great value as an ally to art; but Florentine mosaic can have no such pretensions, and time and money might be better bestowed. The effect is far from pleasing in the chapel I have alluded to, and I think that the art might be advantageously confined *to* the production of small ornaments, for which it is eminently adapted.

An imitation of the pietra dura is now made to a great extent in Derbyshire, where the Duke of Devonshire's black marble, said to be quite equal to the famous Nero Antico, is inlaid with malachite, Derbyshire spars, and other stones; but the inlaying is only by veneers, and not done in the solid as at Florence. This, with the softness of the materials, makes the Derbyshire work much cheaper, and yet, for a table, 20 to 24 inches in diameter, thirty guineas is asked. Were a little more taste in design and skill in execution shown, the Derbyshire work might deserve to be more valued, as the materials, especially the black marble, are beautiful.

I shall now return to cameo-cutting. This art is also of great antiquity, and is pursued with most success in Rome, where there are several very eminent artists now living. Cameos are of two descriptions —those cut in stone, or *pietra dura*, and those cut in shell. Of the first, the value depends on the stone as well as in the excellence of the work. The stones most prized now are the oriental onyx and the sardonyx: the former black and white, in parallel layers; the latter cornelian, brown and white; and when stones of four or five layers of distinct shades or colors can be procured, the value is proportionably raised, provided always that the layers be so thin as to be manageable in cutting the cameo so as to make the various parts harmonize. For example, in a head of Minerva, if well wrought out of a stone of four shades, the ground should be dark gray, the face light, the bust and helmet black, and the crest over the helmet brownish or gray. Next to such varieties of shades and layers, those stones are valuable in which two layers occur of black and white of regular breadth. Except on such oriental stones, no good artist will now bestow his time; but, till the beginning of this century, less attention was bestowed on materials, so that beautiful middle-age and modern cameos may be found on German agates, whose colors are generally only two shades of gray, or a cream and a milk-white, and these not unfrequently cloudy. The best artist in Rome in *pietra dura* is the Signor Girometti, who has executed eight cameos of various sizes, from $1\frac{1}{2}$ to $3\frac{1}{2}$ inches in diameter, on picked stones of several layers, the subjects being from the antique. These form a set of specimens, for which he asks £3000 sterling. A single cameo of good brooch size, and of two colors, costs £22. Portraits in stone, by those excellent artists Diez and Saulini, may be had for £10. These cameos are all wrought by a lathe with pointed instruments of steel, and by means of diamond rust.

Shell cameos are cut from large shells found on the African and Brazilian coasts, and generally show only two layers, the ground being either a pale coffee-color or a deep reddish orange: the latter is most

prized. The subject is cut with little steel chisels out of the white portion of the shell. A fine shell is worth a guinea in Rome. Copies from the antique, original designs, and portraits, are executed in the most exquisite style of finish, and perfect in contour and taste, and it may be said that the Roman artists have attained perfection in this beautiful art. Good shell cameos may be had at from £1 to £5 for heads, £3 to £4 for the finest large brooches, a comb costs £10, and a complete set of necklace, earrings and brooch cost £21. A portrait can be executed for £4 or £5, according to the workmanship.

(TO BE CONTINUED.)

PROGRESS OF THE MECHANIC ARTS.

On Bone, and its Uses in the Arts. By A. AIKIN, *Esq.* [From the Transactions of the Lond. Society of Arts and Manuf.]

Most animals are composed of soft and hard parts: of the latter, some are hard only when of a certain thickness, but when thin, are tough and more or less flexible and elastic; such as the horns of all mammalia (except of the stag tribe), the claws of the lion and tiger, the talons of the eagle, the horn of the rhinoceros, the coriaceous covering of tortoises and crocodiles, and the scales of fishes.

All these, by exposure to a gradually increasing heat, soften, enter into pasty fusion, give out the odor of burnt feathers, burn with jets of flame, and are consumed, leaving behind a very small proportion of earthy matter: 500 grains of horn leave not more than from 0.25 to 2 of phosphate of lime. Boiling water, after long action, takes up from most of them scarcely any quantity of soluble matter, but they are perfectly soluble in caustic alkali, and the solution gives, with acids, a curdy precipitate. They are considered, therefore, as composed of condensed membrane, or, in chemical language, of albumen.

Other hard parts are rigid, considerably harder than the former: when dry, and in many cases when wet, they are very slightly flexible or elastic; and when struck by a hammer, or when bent beyond their power of resistance, break short, with a splintery surface. When exposed to a red heat, with access of air, the membranous or animal part is destroyed; but the earthy part remains in sufficiently abundant quantity to retain the external form, and generally the internal structure, of the entire substance, of which calcined bone and calcined oyster shell are examples. The original hardness of these parts is owing to the abundance of earthy matter that enters into their composition. When such parts are on the outside of the body, they are called, in common language, shells, horns, teeth, according to their position, and the uses for which they seem intended: when they occur within the body, they are called bones.

If, however, we restrict the term bone to its common meaning, we shall exclude the horns of the stag kind, and the substance which forms the body of most teeth, both of which are truly bone, and shall include some substances, such as cuttle-fish bone, which is truly shell.

It is therefore necessary to enter into a more minute examination and

comparison of these hard substances, in order to ascertain which of them are shell and which bone; and, as the result of our inquiry, we shall probably find, with respect to this class of natural bodies as with many others, that although the two extremes of the series are readily enough distinguishable from each other, yet they approach by such insensible intermediate gradations, as to render it impossible to say where the one begins and the other ends.

There is a class of shells, comprising most of the univalves, which are harder than other shells, and when broken, present thick, parallel layers, the layers themselves having usually a finely fibrous structure at right angles to the external surface. These fibres may often be seen to be nothing more than the transverse section of thin transparent parallel lamellæ, which, when viewed on their broad surfaces, often exhibit the usual natural joints of calcareous spar. When such a fracture is viewed by the naked eye, it has a good deal the appearance of porcelain—whence their name of porcellanous shells. When carefully cleansed from all remains of the animal which inhabited them, they give out scarcely any perceptible odor on being made red hot, though their color becomes somewhat gray. When unaltered, they dissolve in dilute acid with much effervescence of carbonic acid gas, and a few hardly appreciable gelatinous flocks remain undissolved. These latter, on being collected and washed, give out when heated a faint odor of burnt animal matter, and become black before they are consumed. By proper chemical tests the soluble part of the shell is proved to have been carbonate of lime or chalk, the particles of which were cemented together with a very minute portion of animal mucus.

Another class of shells is the nacreous, so called from the varying and iridescent colors that they exhibit, resembling those of nacre, or mother-of-pearl; this very substance being, indeed, only a part of a nacreous shell.

These, when heated in a crucible, give out the odor of burnt feathers, often with a perceptible smoke, become of a dark-gray color, and when submitted in this state to the action of acids, there remains undissolved a notable quantity of charcoal. In the recent state they effervesce with weak acids; and when the calcareous matter has been removed, there remains a series of flexible, membranous, or semigelatinous lamellæ, lying parallel to one another, and representing the form of the entire shell. These lamellæ have sometimes a distinctly fibrous structure, parallel to the surface of the shell; and though quite flexible while moist, they shrivel on drying, and become hard like horn—a substance to which they bear the greatest possible analogy. The nacreous shells, therefore, are always very finely lamellar in structure, and are represented by some as composed of alternate layers of membrane and carbonate of lime; but the more probable opinion is, that the calcareous matter is intimately mixed with the membrane, rather than distinct from it. These shells increase in size, in order to accommodate themselves to the growth of the animal, by the deposition of new and larger layers from within; and hence the external surface is covered by concentric furrows or wrinkles, marking the outer margin of each successive layer.

Between the two classes of shells that I have described are others,

the minute structure of which I am ignorant of, but which differ considerably in the proportion and condition of their membranous ingredient.

Thus it appears that all shells, how much soever they may differ from one another in structure, agree in containing carbonate of lime as their only earthy ingredient, and an animal substance nearly resembling if not identical with horn or membrane as their consolidating or agglutinating ingredient.

Exactly the same substances, viz. carbonate of lime and membrane, in various proportions, form the constituent materials of the madrepores and other hard corals.

On examining the hard covering of aquatic crustaceous animals, such as the crabs and lobsters, we find, after the action of acids, that there remains a whitish, soft, elastic cartilage, which represents the original shape of the part, and that the acid solution not only contains lime that had been in the state of carbonate in the original shell or covering, but likewise phosphate of lime, although in smaller proportion than the carbonate. The presence of this earthy salt forms an essential difference in chemical composition between proper shell and the covering of the crustacea, which latter substance may thus be considered as holding an intermediate position between shell and bone.

Some of the corallines, chiefly those belonging to the genera *Gorgonia* and *Antipathes*, approach still nearer in chemical composition to bone; and, indeed, are hardly to be distinguished from it—their earthy part being phosphate of lime with only a small admixture of carbonate, their figure and structure being represented by dense membrane, and, when boiled, they give out a notable quantity of true jelly, which, like other kinds of animal jelly, has the property of forming a precipitate with infusion of galls or of oak bark.

The proportion of membrane in these substances varies considerably, so that while one species almost exactly agrees in composition with the horn of the stag, others contain so much membrane in proportion to earthy matter as to be nearly identical with the bone of the cartilaginous fishes.

If a piece of true bone, in an unaltered state, be put into weak acid, (muriatic acid, on the whole, is the best) a moderate degree of effervescence will take place, showing the presence of some carbonate. By a continuance of this process for some days, all effervescence and chemical action will cease; what remains undissolved will still represent the size and form of the original bone; but it will be semi-transparent, will exhibit a distinctly cellular structure, will be soft, flexible, and, to a certain degree, elastic. If, after being washed, it is boiled in water, it will be found to be in part soluble; and the solution, when boiled down to a proper consistence, will become viscid, and will gelatinize on cooling, and by drying will be brought to the state of hard glue. This jelly, when again dissolved in water, will become curdy, and will give a gray precipitate with nutgall, and will exhibit all the other physical and chemical properties of gelatin; the remaining portion insoluble in water will become hard and somewhat brittle by drying, will burn in the fire like a piece of horn, will dissolve in caustic, fixed alkali forming a saponaceous liquid, and will show all the other properties of albumen or membrane.

The acid in which the bone was first steeped will give an abundant white precipitate of phosphate of lime by means of caustic ammonia, and will give a much smaller precipitate of carbonate of lime by carbonate of ammonia. Thus, by the action of a few simple reägents, the essential constituents of bone are demonstrated. In this summary I have taken no notice of the oil or fat which is contained in the internal bones of all mammiferous animals, because it seems to be by no means an essential part of bone; the horn of the stag and of other animals of the same kind being entirely free from it. On this account it is that hartshorn jelly, made by boiling the shavings of stags' horn in water, is often recommended to persons of very weak digestion in preference to other animal jellies, as being absolutely free from oil; for though hard fat is incapable of dissolving in jelly, yet the softer oily fats will combine with it in small proportion.

But, although it is impossible to draw any marked line of chemical distinction between true bone and the indurated membranous textures that I have already mentioned, yet the mode of their origin furnishes a real and very important difference.

Of the organization of coralline bodies, indeed, we know nothing; for scarcely any of them have been even superficially examined when alive, and, when dried, all trace of structure in the soft parts is completely obliterated.

But with regard to the production of shell, both in univalve and bivalve testacea, we are certain that it never, as such, forms a constituent part of the living animal. A viscid fluid is secreted by certain organs; and it is only when discharged from the body that it assumes the consistence and other characters of shell: therefore, although we may with perfect propriety speak of the structure of shell, as we speak of the structure (that is of the mechanical arrangement of constituent particles) of a crystal, it would be a gross misapplication of terms to speak of the organization of shell; this latter meaning such an arrangement as is compatible with and necessary for the performance of vital functions. Shell is essentially a dead body, or rather one which never was alive; for though naturalists and collectors well know the difference between what they call a dead shell and another, they mean by this expression merely to point out the difference between an empty shell and one the inhabitant of which was alive at the time of its capture.

The way in which the hard covering of the crustacea is annually formed (for these creatures change their shell every year) has not been sufficiently examined to ascertain whether it is at first a mere exudation which hardens out of the body of the animal, or is an induration of the cuticle by the deposition in its pores of calcareous matter conveyed thither by proper secreting vessels. If the former be the case, the shell of the crustacea is analogous to that of the testacea; if the latter, it somewhat resembles bone in the mode of its formation.

With regard to bone itself, there is no doubt that it is as truly organized and vital as any other part of the body. As soon as the rudiments of a young animal can be distinguished before its birth, the place of the future bone is indicated by a soft or semi-fluid matter inclosed in a delicate membrane; by degrees both the membrane and the matter which it incloses become more dense and cartilaginous; opaque white

spots then appear, which soon after are penetrated by vessels carrying red blood; the deposition of bone then begins, and at the same time the cartilage seems to be gradually replaced by membrane. The rudimental bone, which at first was solid, now begins, at least in the long bones, to exhibit an internal cavity or hollow axis; thus showing that while fresh matter is continually depositing to supply the growth of the bone, that which had been already deposited is removed, and that this latter process takes place in the interior of the bone at a greater rate than the other does. The activity of the two vital processes of deposition and removal, or, to speak in technical language, of secretion and absorption, is of course proportioned to the rapidity of growth; so that, during the early periods of life, the bones participate with the soft parts of the body in the continual change and flux that is taking place within them. When the full stature of the animal is attained, these two actions probably diminish in rapidity, but still are kept up sufficiently to preserve the life of the part. As old age approaches, the removal of the earthy ingredient of bone seems to become more difficult; its proportion, therefore, to the membranous ingredient increases, and hence the bones of old animals are harder, of greater specific gravity, and more brittle, than those of younger ones.

That very remarkable natural process, namely, the annual renewal of the bony horns of the stag and other animals of the deer tribe, is perhaps the most striking example and illustration of the circumstances necessary to the formation of bone. These horns arise from a short process or pedestal projecting from a bone forming the upper part of the skull, and called the frontal bone. At the season of the year when the horns are about to be renewed, an increase of vital action takes place in the bone, and a faint red line, indicating the presence of blood vessels, will be perceived in making a longitudinal section of the bottom of the horn and the base on which it stands; the situation of this red line indicating precisely the boundary between the dead horn and the live bone; absorption of part of the bone takes place, which loosens the adhesion of the horn to it, in consequence of which this latter falls by any accidental shock which it receives. The spongy tissue of blood vessels, which may now be seen covering the end of the bony base, is soon entirely covered by the growth of the external skin; and this may be considered as terminating the first part of the process. Soon afterwards a small tubercle arises from the end of the bone, and presses upwards the skin which covers it; the tubercle rapidly elongates, the skin extends with it, and in the course of a few weeks it has assumed the size and shape of the future horn; in this state it is covered by the attenuated skin, which latter has pushed out an abundant growth of short fine hairs, resembling the pile of velvet. Beneath this skin is a layer of blood vessels, the diameter of some of which is equal to that of the little finger; these rest on a thin layer of dense membrane, of the same nature as that which covers ordinary bones, and called the periosteum; and within the periosteum itself is a flexible cartilage, penetrated in all directions by ramifications from the blood vessels already mentioned.

In this state the future horn is very tender and exquisitely sensible: it bleeds when the skin is broken, and the animal often suffers much in this part from the bite of gadflies and other insects. When the cartilage

has attained its full growth, ossification begins, by the deposition of phosphate of lime, and goes on till the bone or horn has acquired its complete hardness. During this process, a ring of bony beads has been forming at the base of the horn, in the intervals between which the main trunks of the blood vessels lie; these beads enlarge by the continual addition of bony matter, and in so doing compress the adjacent sides of the blood vessels, and thus diminish the supply of blood; at length the sides of these vessels are quite squeezed together, circulation ceases, and all the soft parts die, shrivel, and dry up, and are rubbed off by the animal against the bough of a tree, leaving the dead bone or horn attached by its base to the frontal bone; till, after some months, the time for shedding it again comes round, when a repetition of the processes already described takes place.

Bones, even of the same animal, vary much in structure and in hardness, and no doubt in the relative proportion of their component parts, according to the situation in which they are placed, and the use to which they are put. Thus the shafts of the long bones, being wanted chiefly for support, are more or less in the form of a hollow cylinder, and the texture of the bone itself is dense and compact. Those parts of bones that form the joints or articulating surfaces by which one is hinged on to another require a considerable space for the joint, and for the attachment of ligaments; but as a degree of strength proportioned to its thickness is not wanted, the structure becomes cellular. A similar structure is observable in the flat bones, which consist of two thin parallel tables of dense bone, having a cellular part interposed between them. Hence, in utensils made of bone, the compact cylindrical ones are generally employed, both as being stronger and admitting of a more uniform and higher polish.

The bones of animals belonging to the same general class of nature are commonly observed to have certain points of general resemblance, by which they may be distinguished from one another, and are applied by man to various uses corresponding with such differences. Thus, the bones of fishes are softer, more flexible, and contain a much larger proportion of jelly and membrane, or, which comes to the same thing, a much smaller proportion of earthy matter, than those of the mammalia or warm-blooded quadrupeds; and the bones of these latter, comparatively dense and hard as they are, fall considerably short in density and hardness of the bones of birds, which however are generally too small and thin to be applied to much use in the arts.

Bone undergoes much more slowly than the soft parts of animals do the process of spontaneous decomposition; meaning, by this term, that disintegration of a compound which takes place either by the chemical reäction of its ingredients on one another, or by means of air, moisture, and common temperatures. The bones of a human body buried in a church-yard are perhaps mostly consumed in 20 or 30 years; yet under favorable circumstances they will endure for a much longer time with but little change. Thus, in the charnel-house at Morat, in Switzerland, there still remain many bones of the soldiers of Charles the Bold's army, who perished there in 1438, being 401 years ago. When Sir Christopher Wren was rebuilding St. Paul's Church, after the great fire of London, the workmen, in digging for the foundations, came to the floor

of a Roman temple dedicated to the goddess Diana, on which were the horns of stags and bones of other animals. Tombs of the ancient inhabitants of this island are occasionally opened, in which are found bones that have been deposited there during many centuries; and I have the pleasure of exhibiting to you part of a carved bone spoon (discolored and passing to a state of decomposition, it is true) which was found in an Etrurian tomb at Vulsinum, in Italy, possibly as ancient as the foundation of Rome. In the valley of the Lea are many peat mosses, the remains of ancient forests, now covered to the depth of several feet with alluvial silt. Many of these have of late years been dug into, on occasion of making docks and other excavations; and in or upon them have been found the osseous remains of boars, stags, and other animals, which have lain there from the time that these creatures roamed wild in the immediate neighborhood of London. Not only the remains of individuals belonging to species now extant are still found, after being buried for centuries, but the bones of species now extinct, and many of which, judging from the habits of species nearly allied to them and now living, can scarcely exist except in warm climates, are found abundantly in the British islands and in all parts of Europe. Remains of a large animal of the ox tribe are found in Essex. Elephants, hippopotamuses, and rhinoceroses, differing in many respects from any now known to exist, are also found in the same county, and in other places near London. Hyenas and tigers also, of extinct species, occur in the cavern of Kirkdale, in Yorkshire, and in other caverns in the west of England; and in certain caverns in Germany are found the remains of two species of bear, differing in some anatomical details from any known living species of the same genus. There is no evidence that the human race was contemporary with these creatures; and yet, notwithstanding the enormous length of time that must have elapsed since the deposit of the animals in the places where their bones are now found, many of them are in a state apparently of almost perfect preservation. Membrane and jelly still remain in the bones; but the oil or fat, being uncombined with earthy matter, has disappeared.

In what I have hitherto said, I have alluded very slightly to the use of bone in the arts, which was the ostensible object of the present illustration; for I confess that I have not unwillingly been tempted to enter into the preceding physiological and other details, in order to relieve the dryness of mere technical description. In what remains I shall treat of the practical part of my subject, beginning with an inquiry into the use of bones as articles of food.

All animals that eat flesh will likewise eat bones, provided they are of a size to be easily crushed and masticated by them; so when a lion or tiger has taken one of the smaller antelopes, I presume he devours many of the bones along with the flesh, leaving only the spine, skull, and horns. But when he has pulled down a horse or buffalo, the case is different; the flesh alone of the animal is sufficient for an ample repast; the leg bones and ribs are not to be cracked by a single straightforward crush of the jaw; and the spine, from its awkward shape, as well as by reason of the strong ligaments by which its parts are bound together, may well resist the lazy efforts of an animal already satiated with food—not to mention that the great length of the canine teeth in

the larger animals of the cat kind, as well as the small number of their grinders, render the act of gnawing both difficult and unnatural to them. The half-picked carcass, therefore, falls to the share of the wolves and hyenas. The former, after tearing off the ligaments of the joints, proceed to separate the bones from each other; and then, by gnawing, grind off the softer parts of the spongy articulating surfaces, in which they find a wholesome food. The hyena, with far greater strength of jaw and of teeth than any other animal of his size, goes to work bodily, especially on the ribs and other flat bones, crushing them into large, splintery fragments, and swallowing them in this state, without fear of being choked or injured by their sharp points and rough edges. These two animals, therefore, (including the dog, as a sub-species of wolf,) are eminently the bone-eaters; the membranous and gelatinous matter of the bone, being dissolved out by their gastric juice from the earthy portion, undergoes the usual process of digestion; while the latter apparently unaltered, passes through the intestinal canal, giving to their excrements the well-known appearance of half-dried mortar, and may afterwards be applied to all or any of the purposes for which bone-earth is used.

Man, the cooking animal, extracts nutriment from bones in a different way. When very hard pressed, indeed, he can stave off famine for a while, as Captain Franklin and his party did more than once in their exploratory arctic expedition, by taking bones which even the wolves had left, and scorching them so as in some degree to subdue their hardness; and thus render it possible to gnaw and masticate them as a succedaneum for food, or, at least, as some alleviation of the agonies of famine.

But the animal matter of bones is best extracted by hot water. Every housekeeper knows that the nutritive quality of meat soups is much increased by boiling the bones together with the meat. In this way, however, only a small proportion of the food contained in the bones is made available; for part of the gelatin is with difficulty, and the membranous part is not at all, soluble in common boiling water; much even of the fat is locked up in cells of the bone, from which it cannot escape except these cells are broken into.

The solid part of the long bones contains very little soluble matter; it would therefore, in most cases, be a matter of economy to exclude them; the advantage to be derived from them by ordinary treatment not being equal to the value of the fuel which they would require. It is from the enlarged extremities of the long bones and their articulating surfaces that the principal supply of nutritive matter is to be derived; these parts, therefore, should be sawed off from the rest and broken into pieces. From the bones of young animals thus treated, boiling water will, in two or three hours, extract the whole or nearly the whole of the soluble matter; but, in the bones of older animals, the gelatin seems to be in a state of condensation approaching to that in which it exists in skin, and therefore requires the long-continued action of boiling water for its separation. By way of experiment, I had the leg-bone of an ox sawed longitudinally and boiled for three or four hours. At the end of this time, the whole of the fat and mucus had been extracted, with part of the jelly. On applying the finger to the cellular part of the

bone when wiped dry, I found the surface to be considerably sticky, and, on examining the cells, I found many of them completely filled with a transparent substance scarcely viscid, but much resembling pieces of glue that had been put to soak in cold water; by which, as every one knows, the glue swells exceedingly by absorption of the water, without, however, becoming viscid. A second boiling for three or four hours in fresh water dissolved out a considerable proportion of the gelatin; but still the surface of the bone remained sticky, many of the cells had a glazed surface, and, even after a third repetition of the boiling, only a few even of the superficial cells were quite empty. It is evident, therefore, that we cannot avail ourselves, with any regard to economy of fuel, of the whole of the nutritive matter contained in bones by the action of boiling water applied in the common way. But by means of a digester—that is, a boiler with a steam-tight cover and a safety-valve—we can without hazard raise the temperature of water from 212°, its boiling point in the open air, to 270 or 280°. At a less heat than even the former of these, not only the condensed gelatin but also the membranous part of bones is dissolved; and if the bones have previously been reduced to small pieces, the undissolved residue will be found to be a friable crumbling mass, with scarcely any remains of animal matter. It appears that bone soups are thus prepared at present at some of the hospitals and military head-quarters in France, and memoirs have been published, stating the advantage of making a collection of dry bones as part of the provisions of a garrison in case of siege, being a kind of food scarcely susceptible of decomposition or of destruction by rats or mice, and which would require no other magazine than simply making them into stacks and covering them with a roof of thatch or any other material. Complaints, it is true, are made of the burnt flavor which such soups are liable to have, and perhaps it may not be very easy to regulate the temperature of the water in the digester so as to avoid the empyreumatic flavor, and at the same time completely to extract from the bones the animal matter. On this account it is that another scheme has been proposed, namely, to put the bones, after soup has been made of them by boiling in the common way, into a stone trough, and then pour on them very dilute muriatic acid. By repeating this process in the cold a sufficient number of times, the whole of the earthy matter will be dissolved out, and probably without much if any injury to the animal matter, which will remain in the form of a porous membrane; by repeated percolations of water the acid would be washed out; or, if a little should remain, a last sprinkling with a solution of carbonate of soda would convert the acid into common salt. The membrane being now dried in the air, will acquire a horny hardness, by which it will be rendered almost incapable of spontaneous decomposition, and would probably be found to be much more easily convertible into palatable human food by the common processes of cooking than the entire bone. The plan to say the least of it is plausible, provided muriatic acid may be had, as it now may be, at a very small cost.

There is, however, a whole class of animals, the bones of which, without any chemical preparation, are presented to us by nature in a state capable, with very little trouble, of being converted into nourishment. I mean the whole class of fishes. The bones of these creatures

contain so little earth, that, by drying and grinding them, a powder is obtained, which, when made into cakes with meal, has proved a valuable resource to the people of Norway and Sweden in times of scarcity; and some of them, by simply browning on a gridiron, become quite friable, and, when treated with a proper quantity of pepper and salt, form a very palatable article of food.

Instructions for Plaster Casting. In a Letter to the Editor of the London Mechanics' Magazine. By WM. BADDELEY, *Esq.*

The art of copying in plaster is one of great convenience, and admits of a most extensive application; it is one, however, that depends greatly for its successful execution upon the skill and ingenuity of the operator. The mode of proceeding must in all cases be adapted to the particular object in view, and little beyond general directions can be given for the purpose.

The first preparatory step towards plaster casting is to form a mould of the article which is to be copied; there are several methods of accomplishing this, the choice of which must be regulated by the material, form, &c. of the original. The best materials for taking mould impressions from plaster originals, as well as from coins and medals, are a mixture of sulphur and red lead in equal proportions (by weight); the sulphur being melted, the red lead is to be stirred in, and the two ingredients well incorporated together. Some persons prefer a smaller proportion of red lead, while others dispense with it altogether, using sulphur alone; but they are much better combined, as such moulds retain an exquisite sharpness and are very durable. In the case of silver coins, &c. the sulphur mould must not be used, as it would tarnish and injure them. For such purposes, a composition of beeswax, pitch and resin may be used with advantage; or the mould itself may be formed of fine plaster, subsequently hardened with linseed oil. For temporary purposes wax alone may be employed. Whatever material is used, the mode of proceeding is nearly as follows:—

The coin, medal, or original is to be oiled all over with a soft camel's hair pencil or cotton wool dipped in olive oil, taking care that the oil does not remain in any quantity in the hollows; a strip of strong paper, about an inch and a half wide, is to be wound round the edge of the medal, in the form of a cylinder, of which the medal forms the base. The melted sulphur or other composition for the mould is to be poured upon the medal, and when cold may be readily separated from it. The moulds thus obtained are to be surrounded with a paper cylinder and oiled, as before directed; plaster of paris is to be smoothly mixed with water to the consistence of thick cream, *(not Devonshire clouted cream)* and poured into the paper well. If the article to be copied contains much work, with many fine lines, it is well to pour on a small quantity of the plaster first, and urge it into the cavities with a brush, afterwards adding plaster enough to give the thickness required. A very beautiful effect is sometimes obtained by taking a first thin cast of the relieved parts, in plaster which has been mixed with some colored water, as blue, red, green, &c. subsequently adding the pure white plaster to

form the table and substance of the medallion. Of course the converse method may also be adopted, giving a white profile on a colored table.

The foregoing operations relate entirely to comparatively flat objects, which are by far the most manageable, and may be executed with an ordinary share of dexterity: but when the objects consist of busts, figures, &c. in bas-relief, the manipulation becomes more difficult. In that case a different course must be adopted, and various contingencies provided for, requiring a degree of skill only to be acquired by practice, and not to be communicated in any printed directions. In some instances, by filling up the undercuttings with wax or tallow, a mould may be taken in the manner before stated, in a single piece; the undercuttings being afterwards worked out by proper tools in each casting. Other subjects may render it necessary to form the mould of plaster, and divide it into two, three, or a greater number of pieces.

About eight or ten years ago, an ingenious Italian artist exhibited and taught a method of making *elastic moulds*, by means of which he produced some of the most beautiful plaster castings I ever saw, many of them from subjects of more than ordinary difficulty. One was a hand grasping an orange, another a bunch of filberts, from a single mould; but his *chef d'œuvre* was a clinched hand holding a live eel, the convolutions of which, issuing from between the fingers, formed a series of loops that seemed to defy all attempts to perpetuate their appearance by casting. Serpents, lizards, and other small animals upon slabs, may be copied by single moulds of this description very easily; while many bas-reliefs that would require plaster moulds to be divided into a great number of pieces, may by means of the elastic moulds be accomplished with two or three divisions.

To make these moulds, take one part (by weight) of the best glue, and two parts of treacle: the glue having been softened in water, is to be melted, and the treacle added to it. These ingredients should be intimately incorporated together, which is best accomplished by pouring the composition into a tray to cool, and afterwards cutting it up and re-melting it, care being taken to avoid using too much heat. An ordinary glue-pot is a convenient vessel for this purpose.

If the thing to be copied is upon a base, it is to be surrounded with a frame of wood, paper, clay, or other similar material, and carefully oiled; the glue composition is then to be poured into the frame, quite warm. If a figure or bust is to be copied entire, it must be suspended by threads within a box or frame, so as to be surrounded by the composition. When set, if the original cannot be withdrawn without, the mould must be divided with a thin sharp knife, or by means of threads previously laid in a suitable posture upon the model. If the original can be extracted without dividing the mould, any number of plaster casts may be withdrawn in the same way. For immediate use, the treacle may be dispensed with, but the glue alone is decidedly inferior to the composition. These moulds may be used for casting wax as well as plaster, provided the wax is not poured in too hot. Plaster moulds, if used for wax casting, should be well saturated with water, to prevent adhesion. To harden plaster moulds, previous to casting plaster in them, take half a pint of boiled linseed oil, one ounce of oil of turpentine, and brush the mixture over the plaster repeatedly till it

will absorb no more; then put the mould by for a day or two, when it will become very hard, with a good surface, and may be used as before directed.

With respect to the means of hardening the plaster in casting, alum water is said to have this effect, but I have never tried it. It is necessary to use the finest and *freshest* plaster; to mix it smoothly and free from air-bubbles, when the most delicate impressions may be obtained, leaving nothing to be desired on that head. The effects obtained by the stereotype process, especially in copying the finest wood engravings, show how perfectly good plaster will copy the finest lines.

A casting being once obtained, possessed of the desired accuracy, it may be subsequently hardened and rendered durable in several ways: one is, to give it several coats of isinglass, parchment or other fine size, and when it bears up, a finishing coat of copal varnish.

It has been proposed by Sir John Robison, secretary of the Royal Society of Edinburgh, to take casts of the smaller animals in plaster by means of the elastic moulds, and therefrom by Mr. Spencer's electrotype process, metallic counterparts, for the purposes of ornamenting silver and plated goods, in lieu of the distorted and unnatural figures now too often introduced for want of better. In this respect, the discovery of our countryman, Mr. Spencer, seems most opportunely to supply our artisans with a ready means of keeping pace in their productions with the improved and improving taste of the age. What may be the value of this discovery, or what the extent of its usefulness, it is at present impossible to say. They are both immense—but *how* immense, future generations only can determine.

MISCELLANEOUS.

"*Steel Ore.*"—The following is taken from the Report of B. S. Roberts, Esq. Civil Engineer, who during the past season has been employed by the Commissioners for the "proposed Ogdensburgh and Champlain Railroad," in the survey of one of its projected lines, and who has been intrusted with the care of a geological and mineralogical examination of a portion of Franklin and Clinton counties. N. Y. Standard.

"*Steel Ore.*"—In the town of Duane, Franklin county, is a vein of magnetic oxide of iron, distinguished from the other minerals of that region by its capacity of yielding, directly from the process of smelting, a substance possessing all the physical and chemical properties of manufactured steel. The analysis of this ore has been effected by Thomas B. Clemson, an eminent American chemist in Paris, and has been found to be composed as follows:—

Iron and scoria, - - - - - - - - - - - - - -	15.42
Iron alone, - - - - - - - - - - - - - - -	12.90
The part possessing the properties of steel, - -	64.50

From this analysis it appears that the steel properties of the substance resulting from the smelting of this mineral are inherent, and not the result of any new or peculiar process of assay. However little the

world may be prepared to give credit to the existence of such a mineral in the state of an oxide, the fact is now too well established to admit even of skepticism, and no one who will examine the edged tools and cutlery of all kinds that have during the past season been cast from this mineral, and sent out into most of the cities, for samples, can do so great violence to his own senses as to doubt any longer the existence of a "natural steel," from which, by the simple process of moulding and casting, razor blades, penknives, shears, plane irons, gouges, axes of all sizes and descriptions, and every variety of tools of the machinist and carpenter's shop, are at once produced, having all the properties and best qualities of the purest steel.

This interesting mineral differs in its external appearance but little from the other magnetic oxides in its vicinity: its color is darker, it is more highly magnetic, and possesses considerable polarity. The vein was wrought eight or more years before the peculiar properties of the mineral were discovered. It was only distinguished from other mineral of the country by yielding a better quality of iron, and was especially celebrated for wagon-tire and sleigh-shoes, and immense quantities of it were cast into pigs, stove plates, &c. and sold throughout the country for common iron.

The process of the reduction of this mineral differs in no manner from the usual habits of all furnaces, and the rough casting directly from the mould is already prepared for the process of tempering.

The roughness of the castings is very easily removed, and perfect shape and form of all kinds of tools given, with but little labor with the file, grindstone, or turning lathe, in consequence of the extreme softness of the metal before tempering. This quality of softness is not affected by repeated meltings; the substance becomes more fine grained and closely granular by every repeated heating or melting; and after ten or more meltings, crystalizes in so fine a grain as to require the aid of a glass to discover the granular texture. The steel property cannot be destroyed by any heat, nor by any number of meltings: in this particular it possesses one of the most important advantages over manufactured steel: the means which entirely destroy the steel properties acquired by cementation, only tend to refine this mineral by driving off its impurities, and refining its crystalization, and improving its capacity for the most refined cutlery. The following are some of the economical and inherent advantages of this steel, viz:—

1. The great expense of the manufacture of steel by the tedious and difficult process of cementation, is all avoided; this mineral possessing the property of yielding a superior steel, with the slight comparative expense and labor of casting and the bloomery process.

2. From its capacity to retain its steel qualities, resisting the most intense heat of the furnace or forge through repeated meltings.

3. The ease of giving it form by the simple process of moulding, and thereby saving the expense of reducing ordinary steel to given shapes under machinery and the hammer. The large and heavy parts of the machinery of steam-engines, &c. where great strength and hardness are necessary, can be cast with the most perfect accuracy, and at the reduced and very small expense of common castings from iron. An incalculable amount of the usual labor of making the heavy parts of such

machinery, when the strength and hardness of steel is necessary, will thus be saved.

4. All tools cast from this mineral being entirely steel, will of course much longer resist the wear and tear of usage than those which have simply an edge of steel welded.

5. From its softness before the process of tempering. The machinery of factories, whose parts must fit their places in the machine with extreme accuracy, will be made at a very reduced expense, in consequence of the ease of giving the parts more perfect form by moulding and the turning lathe, and in the subsequent tempering of the parts just such a degree of hardness can be obtained as their particular places and capacity in the machine may require.

6. In small tools and cutlery, by giving them shape and form at once by casting, saving thereby the immense expense and labor of giving shape to the same by the usual means of machinery and the hammer.

7. A great gain in the general economy of time and labor.

8. The great reduction it will effect in the economy of steel, and the variety of edge tools and cutlery; which probably more than any other affects the public and general good, and which is in fact a consequence of all the others.

The Thames Tunnel.—The shaft on the Wapping shore, in which a footway descent is to be made into the Thames Tunnel, is proceeding very rapidly, and as it is built above ground, presents a very commanding appearance, and will be gradually sunk. The works below have been for some time suspended, the Tunnel having been completed to within the limits of the Company's wharf on the Middlesex shore, far beyond the low-water mark. When the shaft is completed on the north side, the excavations will be resumed; and as there is now no fear of another irruption, the remaining portion of the Tunnel can be completed in a few weeks. It is confidently expected that the Tunnel will be opened for foot passengers on or before next July. The arches of the Tunnel are in a sound state, and bear evidence of the care taken in the execution of this great and expensive undertaking.

A Duck in a Cod's Stomach.—A gentleman in Edinburgh having purchased a cod, opened it, in the hope, from its enormous size of belly, to find a large roe; but no roe was forthcoming. Observing, however, the stomach of the fish unusually distended, the purchaser again applied the knife, and to his astonishment found therein a fresh teal duck, quite entire, and not even a feather ruffled.

Phenomena of Sound.—In the arctic regions, persons can converse at more than a mile distant when the thermometer is below zero. In air, sound travels from 1130 to 1142 feet per second. In water, sound passes at the rate of 4708 feet per second. Sound travels in air about 900 feet for every pulsation of a healthy person, at 75 in a minute. A bell sounded under water may be heard under water at 1200 feet distance. Sounds are distinct at twice the distance on water that they are on land. In a balloon, the barking of dogs on the ground may be heard at an elevation of three or four miles. On Table Mountain, one mile

above Capetown, every noise in it, and even words, may be distinctly heard. The fire of the English on landing in Egypt was distinctly heard 130 miles on the sea. Dr. Jamison says, in calm weather he heard every word of a sermon at the distance of two miles! Water is a better conductor of sound than air. Wood is also a powerful conductor of sound, and so is flannel or ribbon. Sound affects particles of dust in a sunbeam; cobwebs and water in musical glasses; it shakes small pieces of paper off a string in concord. Deaf persons may converse through deal rods held between the teeth, or held to the throat or breast. Echoes are formed by elliptical surfaces combined by surrounding surfaces, or by such of them as fall into the respective distances of the surface of an ellipse, and are therefore directed to the other focus of the ellipse; for all the distances from both foci to such surface are equal, and hence there is a concentration of sounds at those points, direct from one focus, and reflected back again from the other focus. An echo returns a monosyllable at 70 feet distance, and another syllable at every 40 feet additional. The echo of artillery is increased or created by a cloud or clouds. Miners distinguish the substance bored by the sound; and physicians distinguish the action of the heart by a listening tube. Gamblers and piemen can distinguish, in tossing money, which side is undermost, though covered by the hand.

To reduce Oblique Lines to the Horizontal Plane.—As a subscriber to your Journal, I am desirous of contributing my mite of information, in return for the very many useful remarks on surveying, which I have observed in your pages. Probably you may not think the contrivance worthy of attention, but I can assure you that in surveying a rugged, hilly district, such as this, I find it exceedingly useful, and it effects a great saving of time from the absence of all calculation. My contrivance is simply explained by ruling a sheet of paper into twenty squares—say, that each of these squares represents one chain; then, by marking the angles of a quadrant without these squares, from one degree to ninety, and having the angle of inclination and surface distance of any portion of ground, I can instantly determine the length of the base or horizontal distance by merely laying a straight edge to the degree of inclination, marking off the measured distance, and letting fall a perpendicular on to the base. In like manner, by bearing the surface distance and angle of inclination, I can as easily determine the height by the same simple contrivance. I do not mean to assert that this method is absolutely accurate, but it is easy of performance, and sufficiently near the truth for all common purposes of surveying, and as such, I think likely to be of use to the land surveyor, who, in most instances, even when capable of performing the calculations, is, from the lowness of his remuneration, little disposed to investigate the matter farther than to avoid any gross error which might arise from leaving this part altogether unattended to.

Correspondent of London Surv. &c.

Four and Six Wheel Engines.—Having been requested to furnish a statement of the reasons why the locomotive engine on four wheels is preferable to the one on six, I beg to submit the following, viz:

1. The engine on four wheels is less costly than the one on six wheels;

therefore, to have the same number of engines, or the same power, on a line of railway, less outlay of capital is required.

2. It allows the engine to be got into less space; consequently more compact, firmer, less likely to derangement, and much lighter.

3. Though the engine is lighter, the adhesion is more perfect, from the weight on the driving wheels remaining uniform, however unequal or out of level the rails may be, enabling the maker to equalize the strain and adhesive power at the same time; as it is lighter, there is less power required to take it up the inclines, therefore more available power to take up the train.

4. The engine is safer, as it adapts itself better to the rails, not being so likely to run off the line at curves or crossings.

5. It is more economical in the working, as there is less expense of interest and of depreciation, fewer parts in motion, consequently less friction, or wear and tear, as there are fewer parts to maintain.

6. The engine being more simple in its construction, in addition to the advantage of having fewer parts in motion, those parts are more easily got at, therefore much less expense is incurred in those repairs which are common to both plans.

7. The buildings, turn tables, and other costly conveniences necessary for the maintenance and repair of the engines, are not required on so large and extensive a scale, as the engine on four wheels occupies much less space than the one on six wheels.

8. As there are fewer parts to maintain in the four-wheeled engine, fewer tools—such as lathes, drills, smithies, &c.—are required for the repairs of the one engine than the other.

9. As the engine is more simple, having fewer parts likely to derangement, there are fewer chances of delays or stoppages during the journeys or the times of taking the trains. Ibid

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Malleable Glass.—"Pliny, Petronius, Isidorus, and others, report that an artificer was presented to Tiberius who had invented a malleable glass, which being cast on the ground, was bent, but not broken, and being taken up by the same artificer, was with his hammer brought to the former form and beauty. His reward, besides the wonder and astonishment of the beholders, was that which precious things often procure their owners; for the emperor, asking whether any other knew this mystery? this being denied, he caused his head (the only workhouse of this secret) to be smote off, lest gold and silver should give place to art."—*Purchase's Revelations of the World, London*, 1617, *p.* 901.

Solution of the Disc Problem.—A correspondent of the London Mechanics' Magazine, under the signature of *Omicron*, offers the following solution of the disc problem, or pneumatic paradox as it is more commonly called:

"The phenomenon is due to the atmosphere. This ought to have appeared sufficiently evident, seeing that, whether the disc were at top or bottom of the tube, the same result followed, the pressure or resistance of the atmosphere being equal on every side.

"Let a cylinder be placed round the disc, open at top, through the bottom of which the tube is admitted; let the cylinder be wider than

the disc, leaving it room to play; now apply a weak blast, and the disc will not be blown out of the cylinder, but let a blast sufficiently powerful to overcome both the resistance to the area of the disc, and the waste of the escape by the sides of the cylinder, under these circumstances the disc will be blown *out* of the cylinder, although it may still be held *over* the cylinder. What is this but the atmosphere?

"Again, let a segment of the arc of the disc be *loaded*, say with a bit of lead, and the blast applied in the ordinary way of the experiment, in this case the disc will *turn* over as on a hinge, and be blown off the tube. Surely those who attribute an attractive power to the blast *per se*, will not assert that a piece of lead could destroy such a formidable foe.

"Leaving the matter now to the consideration of your able correspondents, I shall conclude by advising what seems to me likely to be productive of some slight benefit in many cases, namely, that the safety valves for steam boilers be attached by a hinge or pivot, as pointed out in the experiment of the loaded disc."

Power of Steam.—A pint of water converted into 216 gallons of steam will raise 37 tons a foot high; and if the steam be allowed to expand to double that volume, twice that weight. The greatest load ever lifted by any steam-engine in England was by one in the Consolidated Mines in Cornwall, on the expansion principle, which raised a load of 90,000 lbs. 7 feet 6 inches high every double stroke it made, and this nine times a minute. Mechanics' Almanac.

Modern Improvements in the manufacture of Iron.—The modern progress of the iron manufacture is by few facts more strikingly exemplified than by this, that formerly it required more than four tons of engine coal for the production of one ton of iron; while, in consequence of the numerous improvements introduced, chiefly within the last thirty years, half a ton only is now the average quantity required; that is to say, above eight times the quantity of iron is obtained from the same engine power. Ibid.

Grease adapted to Carriages and Machines of all sorts.—This composition prevents friction to a great extent, and of course lessens the wear of all rubbing surfaces. Its cost is not comparatively greater than the materials often employed for the purpose. It is not changed by heat, and hence does not liquify and flow away from its proper place:

Black lead, pulverized, - - - - -	50	parts,	by weight.
Hog's lard, - - - - - - - - - -	50	do.	do.
Fresh soap, - - - - - - - - - -	50	do.	do.
Quicksilver, - - - - - - - - -	5	do.	do.

At first, amalgamate well the lard and mercury, by rubbing them together for a long time in a mortar; then gradually add the black lead, and lastly the soap, mixing the whole as perfectly as possible.

Rec. Soc. Polytech. Jan. 1839.

Salting and Curing Animal Substances.—Our attention has been invited to a new process, protected by letters patent, for the above purpose. The advantages enumerated in the circular are:

"1. The whole process of curing effectually the animal substance does not occupy more than one quarter of an hour, economizing thereby labor and time to a very great extent.

"2. At any season of the year, and in any temperature, even under the influence of a tropical sun, the process is effective, and may be used with perfect safety.

"3. The materials employed are the same as hitherto used, but less than one-third of the usual quantity is consumed.

"4. Any desired flavor, and any degree of saltness, may be communicated, the process being thus equally applicable to hams, tongues and other preparations as to plain salting. Fish, poultry, &c. may also be treated with equal advantage.

"5. By this process the nutritious elements of the animal substance are all preserved in it, which by the old mode of curing are necessarily much deteriorated.

"6. By this process, hides can be prepared for packing with great advantage, occupying much less space, thoroughly preserved, and rendered fitter for the tanning process."

We think no one will deny the great benefits the foregoing, if realized, would confer upon the consumers in general, as well as upon those connected with the provision trade. And we have no hesitation in adding our testimony to their truth, excepting only the 2d and 6th. These require further proof than a single inspection. We have not the slightest reason, however, to doubt the accuracy of the facts stated therein. The process must be altogether independent of temperature. And as to its use for the preservation of hides, if a hare-skin submitted to it be sufficient evidence, and if alum or any other antiseptic, mixed with the brine, be an improvement in the skin for the tanner's use, the condition of the skin we saw, and the certainty of the ease with which the alum may be applied for its benefit, remove our exceptions, and then the whole advantages will have received our unreserved testimony.

The meat to be cured is placed in an iron vessel of considerable strength, connected by a pipe and stop-cock with the brine tube, also with an exhausting pump. The cover having been screwed down on the vessel, the air is extracted and a vacuum established, whereupon, the stop-cock being properly turned, the brine rushes in and takes the place of the air, filling the pores of the meat, and penetrating thoroughly the animal substance. Lest, however, some parts of the meat might not have been impregnated with the pickle by this reäction and the common atmospheric pressure, more of the liquid from the tub, prepared to taste with salt alone, or with saltpetre, or sugar, or spice, or alum in the case of hides, is pumped in by a small condensing engine (connected of course also with the iron vessel) until a pressure of from 150 to 200 pounds on the square inch be attained. Now, the animal snbstance is allowed to remain under pressure for about ten minutes, and the process is complete. The meat when taken out is thoroughly saturated with the brine, the full flavor of which is imparted to it, and well cured, as it is termed. We tested this by tasting a piece of mutton, which with other meat had been so treated on the occasion of our visit, and broiled immediately. The brine returning to the tub has no appearance of having been in contact with animal matter. The Russian consul was

present, and appeared to be much interested in the process. A lump of beef was cured for his table. Further, we can only say that previously to witnessing the process, we had tasted a slice cut from the centre of a piece of beef, 9 lbs. in weight, and that it was most delicious. Morning Post.

Umbrellas in Italy in 1590.—"To avoide the beames of the sunne, in Italy, they carry Vmbrels, or things like a little canopy, over their heads; but a learned physician told me that the use of them was dangerous, because they gather the heate into a pyramidall point, and then cast it down perpendicularly upon the head, except they know how to carry them to avoid the danger."

DESCRIPTION OF AMERICAN PATENTS

Granted from Dec. 14th, 1840, to Jan. 9th, 1841.

Improvement in Apparatus for producing a Vacuum for raising Water, &c. By Eugene Ablon, Paris, France, assignee of Pierre Ravard. Dec. 17th.

Claim.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have constructed and combined the several parts of the apparatus for effecting the rarefaction of air by the rapid emission of steam from a steam generator; reference being had to drawing No. 1 for a general exemplification of this combination, which consists mainly in the cylinder X, its contained tube or tubes for the efflux of air, the air vessel connected therewith, and the manumeters or guages for indicating the degree of exhaustion I do not claim either of these parts, taken separately, as of my invention; but I do claim the so arranging and combining them, substantially as herein set forth, as to adapt them to the purpose of producing and indicating the degree of exhaustion in my hydraulic apparatus.

In the hydraulic apparatus, I claim the arrangement and combination of the receivers and reservoirs, as described in the first modification thereof, or of the reservoirs alone, as described in the second modification thereof, with the floats, air valves, and tubes for the exhaustion of air, situated immediately above the floats as described, so as to coöperate with each other in the manner, and to produce the effect as herein set forth; and these I claim, together with such modifications thereof as are analogous in construction and mode of operation, and which in consequence thereof produce a like effect.

Improvement in Machinery for making Pipes continuously from Lead, &c. By George Escol Sellers, Upper Darby, Del. Dec. 17th.

Claim.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner of forcing the lead from the melting pot by means of the pressure of air, in the manner herein set forth. I also claim the manner of cooling the nozzle, or former, by the circulation of cold water around it, in the manner herein fully made known.

Improvement in the mode of connecting the Piston Rod with the Pistons of Steam Cylinders. By MATTHIAS W. BALDWIN, Philadelphia, Pa. Dec. 17th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the attaching of the piston rod of a double acting steam, water, blowing or other engine, directly to the lever beam or crank at one end, and to the piston at the other, causing the said piston rod to pass through a stuffing box, connected with a jointed hub or with a slide, so formed and arranged as to admit of the lateral vibration of the piston rod, substantially in the manner herein set forth.

Improvement in Cooking Stoves. By JORDAN L. MOTT, New-York. Dec. 17th.

CLAIM.—What I claim in this part of my improvement, is the combining with a cooking stove of any of the kinds in which roasting is to be effected in front, two moveable jambs and a tin reflector, arranged and operating substantially as herein described.

What I claim as constituting my second improvement in cooking stoves, is the above named fuel saver, door or shutter, as constructed and combined with the hearth, front plate, and fire-place of a cooking stove of any kind to which it can be adapted, in the manner herein set forth, by which said door is rendered capable of being raised or lowered, inclined forward or converted into a hood or shelf, for the purposes and in the manner herein fully made known.

Improvements in the process of Tanning. By DANIEL HOWELL, New York, assignee of Walter Buchanan, Milford, Pa. Dec. 17th.

CLAIM.—What I claim therefore as my improvements, and desire to secure by letters patent, is the tanning of hides and skins, by attaching them to or hanging them by the slats or rounds of a wheel, such as is herein described; said wheel being placed over a tan vat, in such manner as that by its revolution the skins shall be alternately dipped into and raised from the tanning liquor by a motion which is to be continuous or nearly so, during the process; not intending however by the foregoing claim to limit myself to the precise form of the apparatus as herein described, but holding myself at liberty to vary the same as I may think proper, whilst I attain the same end by means substantially the same.

Improvement in Trusses for the cure or relief of Prolapsus Uteri. By GOODOWN BRIGHT, Bellbrook, Ohio. Dec. 17th.

CLAIM.—What I claim therein, and desire to secure by letters patent, is the manner of attaching to the abdominal pad, an elastic, bifurcated wire or steel spring, carrying a perineal pad, the same being constructed and operating in the manner and for the purpose herein fully made known.

Improvements in the Machinery for and manner of spinning Silk, such as Sewing Silk, Twist, &c. from the Cocoons. By GEORGE HERITAGE, Chestertown, Md. Dec. 19th.

CLAIM.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the combining of the revolving

basins or vessels in which the cocoons are contained, with the apparatus for spinning the same into thread; the single strands receiving their twist from the revolution of the basins, and these being doubled and twisted by the spinning apparatus; the whole being arranged and combined substantially in the manner herein set forth.

I also claim the use of the graduated square, or triangular shafts, for the purpose of holding the strands and unwinding the silk from the cocoons with different velocities, in the manner and with the intention described.

Improvement in the Machinery for and manner of Reeling Silk from the Cocoons. By GEORGE HERITAGE, Chestertown, Md. Dec. 19th.

CLAIM.—What I claim as my invention in the above described machine, and desire to secure by letters patent, is giving to the threads of raw silk, in the operation of reeling the same from the cocoons, such a degree of twist as may be desired, by giving a revolving motion to the basins, or vessels in which said cocoons are contained, the same being effected by means of an apparatus constructed substantially in the manner herein fully set forth.

Improvement in Cooking Stoves. By WM. MELSHEIMER, Philadelphia, Pa. Dec. 19th.

CLAIM.—What I claim therein as constituting my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the four ovens, as above described; that is to say, there being two ovens, one at each end of the fire chamber; one immediately behind the fire chamber, with a flue passing over the top of it only; and the fourth, or principal oven, situated immediately above this, and extending in part over the fire chamber, as set forth. I also claim the manner of graduating and arranging these flues, so as to render their regulation by dampers unnecessary, when the oven is to be heated, said graduation and arrangement being substantially the same with that herein fully made known.

Improvement in Spark Arresters. [Patented 10th Sept. 1840.] By LEONARD PHLEGER, Philadelphia, Pa. Dec. 28th.

CLAIM.—What I claim as constituting my improvement in this modification of my spark arrester, is the using of a conical or cylindrical tube B B, perforated with large holes, as described; the metallic cap I I, and the other parts described, being so arranged as to be adapted thereto, substantially in the manner set forth.

Improvement in the Cooking Stove. By JOEL GREEN, Rochester, N. Y. Dec. 28th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the arrangement of the side flues in combination with the angle flues and funnel, as before described. Likewise, the arrangement of the registers for governing the draft in combination with the oblique plates under the oven, as described.

Improvement in the Windmill, &c. By ISAAC GARVER and SAMUEL FAHRNEY, Boonsborough, Md. Dec. 28th.

CLAIM.—What we claim as our invention, and which we desire to secure by letters patent, consists in the before described arrangement of the inflexible rods D, attached to the backs of the sails B, and to the rim of the thimble E, and in combination therewith a spring G, for keeping the springs in an extended position, instead of cords and weights which have been used.

Improvement in the Fire Alarm. By RUFUS PORTER, Billerica, Mass. Dec. 28th.

CLAIM.—I do not claim as my invention the employment of the expansion of a bar of metal by heat, to disengage or let off an alarm; but what I do claim as my invention, and desire to secure by letters patent, is the combination of the metal plate C D, the hook F, the catch Y, the lever X, and the hammer M, for the purpose and in the manner described. I also claim the escapement wheel J, in combination with the dogs K and L, for the purpose and in the manner described.

Improvements in the construction of Railways, and in the means of applying power to propel Carriages thereon. By JOHN RANGELEY, Camberwell, England. Dec. 28th.

CLAIM.—But what I claim is the mode herein described of constructing railways, whereby the power employed to propel carriages thereon is transmitted by a series or train of wheels, revolving on axles supported on stationary bearings fixed in the line of railway, and in such manner that the carriages for passengers and goods are caused to pass over and be acted on and moved by the rotary motion of such wheels, by the contact and friction of their peripheries acting against the under sides of the pair of running rails attached to each carriage, the wheels being driven by endless bands leading from the moving power.

Improvement in the mode of constructing and securing Wing Gudgeons for Mills. By DAVID PHILIPS, Georgetown, Pa. Dec. 28th.

CLAIM.—What I claim as new and of my invention, and which I desire to secure by letters patent, is the mode of attaching and securing the gudgeon to the shaft by means of the notched arms and keys, as before described.

Improved Apparatus for Cooking. By JOSHUA GRIME, Beekmantown, N. Y. Dec. 28th.

CLAIM.—What I claim as my invention, and for which I desire letters patent, is the combination of a chimney flue or other convenient means to create a draft and carry off the smoke, gas, &c. with a closet constructed with the opening G, the fire-place F, and the opening and damper H; the whole being constructed substantially as above described.

Improvement in the Coffee Roaster. By ABEL STILLMAN, Poland, N. Y. Dec. 28th.

CLAIM.—What I claim is combining the coffee roaster with a rim or vessel open below, so as to admit the fire to the roaster, and adapted to

the stove, portable furnace, or fire-place, as herein set forth, and the insertion of a piece of mica or other transparent substance in the end of the cylinder.

Improvement in Spark Arresters. By DAVID MATTHEW, Schenectady, N. Y. Dec. 31st.

CLAIM.—The undersigned claims as his own invention the combination of the plates H and A, constructed in the manner described above, having a wire gauze arranged between them, with the casing surrounding the chimney of the locomotive, in the form as set forth.

Improvement in Locomotive Engines. By MATTHIAS W. BALDWIN, Philadelphia, Pa. Dec. 31st.

CLAIM.—I claim the substituting a metallic stuffing, consisting of wire instead of cotton, hemp, wool, or the other fibrous materials ordinarily employed, whether the same be used around the stems of valves, in stuffing boxes, or in other situations where such packing is required.

I claim the combining of spiral springs with the cylindrical boxes and pedestals for the wheels of locomotive cars, &c. constructed and arranged as herein set forth.

Improvement in the construction of Valves for Pneumatic Railways. By SAMUEL CLEGG and JACOB SAMUDA, England. Dec. 31st.

CLAIM.—We do not claim the precise size or form of the various parts, or the using of the precise materials herein described; but we claim exclusively the method of constructng and using valves as above described, and combining the same valves in the manner above described herein, for rendering available the application of direct tractive force, either on railways or otherwise.

Machine for graduating the velocity of moving Bodies. By EDWIN W. JACKSON, Albany, N. Y. Jan. 5th, 1841.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the mode of graduating the velocity of moving bodies by means of a changeable weight, such as quicksilver, water, sand, shot, &c. contained in receptacles of any given form arranged around or between two concentric cylinders or wheels, and communicating with each other by apertures in the partitions or divisions thereof, through which the changeable weight passes as described.

I also claim the mode of regulating the velocity of the moving body by means of valves or shutters which enlarge or diminish the size of the apertures through which the changeable weight passes as described.

Improvements in the Horse Power for driving machinery. By EDMUND WARREN, New-York. Jan. 5th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the combination of the disc, or main wheel arranged as a disc, with the springs upon it, and the lever, as a means of relief, or to prevent breakage of the machine.

Improvement in the Apparatus for steering Steam-Boats. By RUSSELL EVARTS, Madison, Conn. Jan. 5th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, consists in attaching a segment grooved wheel to the heads of the rudder, around which the steering chains are passed, and to which they are made fast in such manner that the purchase shall always be at right angles to the diameter, in combination with the grooved drums on the horizontal shaft around which the steering chains are wound, one on each side, and the gearing for turning said drums at a quicker or slower speed, by the arrangement of the cog wheels in the sliding frame, as before described.

Also, the arrangement of the life chains leading from the rudder to the windlass, as before described, along the gunwales.

Improvement in the construction of Blast Furnaces. By STEPHEN CHUBBUCK and JEDEDIAH BRIGGS, Wareham, Mass. Jan. 9th.

CLAIM.—What we claim as our invention, and which we desire to secure by letters patent, is the mode of keeping the metal in its liquid state to a proper degree of heat, by means of fires surrounding the basin containing said metal, and kindled and kept alive in an arch arrangement, in the manner herein set forth; and in combination with the foregoing arrangement, the flue B, governed by a damper K, so operating as to permit the draft from the fires in the arch to ascend the flue B, or when closed, forcing it into the smelting stack *a b c*, as herein set forth.

LIST OF ENGLISH PATENTS

GRANTED BETWEEN THE 27TH OF NOVEMBER AND THE 23D OF DECEMBER, 1840.

Miles Berry, of Chancery-lane, patent agent, for certain improvements in looms for weaving. November 27; six months.

John Clay, of Cottingham, York, gentleman, and Frederic Rosenborg, of Sculcoates, in the same county, gentleman, for improvements in arranging and setting up types for printing November 27; six months.

John Condie, manager of the Blair Iron Works, Ayr, Scotland, for improvements in applying springs to locomotive railway and other carriages. November 27; six months.

George Holworthy Palmer, of Surrey-square, civil engineer, and Charles Perkins, of Mark-lane, merchant, for improved constructions of pistons and valves for retaining and discharging liquids, gases and steam. November 28; six months.

George Blaxland, of Greenwich, engineer, for an improved mode of propelling ships and vessels at sea and in navigable waters. November 28; six months.

Henry Bridge Cowell, of Lower-street, St. Mary, Islington, ironmonger, for improvements in taps to be used for or in the manner of stopcocks, for the purpose of drawing off and stopping the flow of fluids. December 2; six months.

James Robinson, of the Old Jewry, manufacturer of machinery, for a sugar-cane mill of a new construction, and certain improvements applicable to sugar-cane mills generally, and certain improvements in apparatus for sugar making. December 2; six months.

Alexander Horatio Simpson, of New Palace-yard, Westminster, gentleman, for an improved machine or apparatus for working pumps. (A communication.) December 9; six months.

William Peirce, of George-street, Adelphi, gentleman, for improvements in the preparation of wool, both in the raw and manufactured state, by means of which the quality will be considerably improved. December 9; six months.

Charles Winterton Baylis, of Birmingham, accounting-house clerk, for an improved metallic pen, to be called the patent flexion pen and improved penholder. December 16; six months.

George Wildes, of the city of London, merchant, for improvements in the manufacture of white lead. (A communication.) December 16; six months.

James Davis, of Shoreditch, engineer, for an improved mode of applying heat to certain steam-boilers. December 16; six months.

John Steward, of Wolverhampton, esquire, for an improvement in the construction of pianofortes, harpsichords, and other similar stringed musical instruments. December 16.

James Molyneux, of Preston, for an improved mode of dressing flax and tow. December 16; six months.

Charles Botton, of Farringdon-street, gas engineer, for a certain improvement in gas meters. December 16; six months.

Hugh Graham, of Bridport-place, Hoxton, artisan, for a new mode of preparing designs and dyeing the materials to be used in the weaving and manufacture of Kidderminster carpets, and for producing patterns thereon, in a manner not before used or applied in the process of weaving and manufacturing such carpets. December 16; six months.

Joseph Beathic, of Portland-place, Wandsworth-road, Lambeth, engineer, for certain improvements in locomotive engines, and in carriages, chairs, and wheels, for use upon railways, and certain machinery for use in the construction of parts of such inventions. December 16; six months.

Andrew Pruss D'Olszowski, of Ashley-crescent, gentleman, for a new and improved level for ascertaining the horizon, and the several degrees of inclination. (A communication.) December 16; six months.

William Tudor Mabley, of Wellington-street North, mechanical draftsman, for certain improvements in producing surfaces to be used for printing, embossing, or impressing. December 17; six months.

Abraham Alexander Lindo, of Finsbury-circus, gentleman, for improvements to be applied to railways and carriages thereon, to prevent accidents, and to lessen the injurious effects of accidents to passengers, goods, and railway trains. December 18; six months.

Elias Robison Handcock, of Birmingham, esquire, for certain improvements in mechanism applicable to turn-tables, for changing the position of carriages upon railroads, for furniture, and other purposes. December 18; six months.

Richard Coles, of Southampton, slate merchant, for improvements in machinery or manufacturing tanks and other vessels of slate, stone, marble, and other materials, and in fitting and fastening such materials together. December 23; six months.

Benjamin Baillie, of Henry-street, Middlesex, for improvements in locks, and the fixings and fastenings thereto belonging. December 23; six months.

John Brumerell Gregson, of Newcastle-upon-Tyne, Northumberland, soda-water manufacturer, for improvements in pigments, and in the preparation of the sulphates of iron and magnesia. December 23; six months.

Frederic Payne Mackelsan, of Birmingham, and James Murdoch, of Hackney-road, civil engineers, for certain improvements of or belonging to tables, a portion of which is applicable to other articles of furniture. (Partly a communication.) December 23; six months.

George Thornton, of Brighton, civil engineer, for certain improvements applicable to railways, locomotive engines, and carriages. December 23; six months.

John Dickinson, of Bedford-row, esquire, for certain improvements in the manufacture of paper. December 23; six months.

David Walther, of Angel-court, Throgmorton-street, merchant, for certain improvements in the methods of purifying vegetable and animal oils, fats, and tallows, in order to render those substances more suitable to soap-making, or for burning in lamps, or for other useful purposes, part of which improvements are also applicable to the purifying of the mineral oil or spirit, commonly called petroleum or naphtha, or coal oil, or spirit of coal tar. December 23; six months.

John Jones, of Leeds, brush manufacturer, for improvements in carding engines for carding wool and other fibrous substances. (A communication.) December 23; six months.

Joseph Barker, of Regent-street, artist, for improvements in gas meters. December 23; six months.